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Environmental Trends in British Columbia 2000

BRITISH COLUMBIA

Ministry of Environment, Lands and Parks

State of Environment Reporting

ON THE COVER

The Vancouver Island Marmot, *Marmota vancouverensis*, is a highly social animal that lives only in the high mountains of Vancouver Island, British Columbia. It is shown on the cover holding common paintbrush, *Castilleja maniata*, a dietary favorite during summer months, and standing in a subalpine field of assorted grasses, which are also major food items. The Vancouver Island Marmot is the world's rarest marmot with 50 animals left in the wild. Forestry in the mountains has concentrated this small population, making it susceptible to natural conditions such as bad weather, disease and predation. A recovery project is in place to restore the population to between 400 and 600 marmots distributed in three separate mountain areas on Vancouver Island. The Vancouver Island Marmot is listed as endangered in British Columbia and is reported on as part of the Species at Risk Indicator (page 36).

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A technical compendium documenting methodologies and presenting the data behind each indicator is available on the Internet or in hardcopy on request.

Comments may be emailed to: risa.smith@gems9.gov.bc.ca

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Purpose of Environmental Indicators

Statistical measures of human well-being, presented in the form of economic and social trends, have long been used as powerful tools for gauging the status of economic and social systems. Indicators such as gross domestic product, unemployment rates and the consumer price index are routinely used by decision-makers in government, industry, small business and communities to shape policies and redirect resources. Less pervasive, but equally important, are indicators of ecosystem or environmental well-being.

Environmental Trends in British Columbia, 2000 is the second environmental indicators report released by the British Columbia Ministry of Environment, Lands and Parks. This report presents fifteen key indicators (page 2) on the state of British Columbia's environment. There are four new indicators: Green Economy; Water Use; Forest Riparian Ecosystems; and Global Climate Change. The other eleven provide updates of information presented in *Environmental Trends in British Columbia, 1998*. Each indicator provides a picture of the status or trends for one issue. When viewed together, these fifteen indicators provide: an overview of the condition of British Columbia's environment; important links between seemingly disparate issues; and a picture of the way in which British Columbians are collectively responding to environmental challenges.

The development of environmental indicators is rapidly emerging as an important tool to encourage the incorporation of environmental information into all decision-making. They are being used by international organizations, such as the Organisation for Economic Co-operation and Development; by national organizations, such as Environment Canada, Statistics Canada and the US Environmental Protection Agency; and by many provincial organizations, such as the indicators developed to measure progress on the *Provincial Health Goals for British Columbia* (1997).

With the publication of this second report in the *Environmental Trends* series, British Columbia is establishing itself as a leader in the development and presentation of environmental indicators.

A commitment to accountability

In 1995, the Auditor-General of British Columbia recommended enhancing the accountability of government through the development of performance measures. One recommendation was that performance measures focus on the ultimate outcomes of government efforts, in addition to the intensity of the efforts themselves. This means, for example, that it is as important to report on the concentration of atmospheric pollutants as it is to report on the number of permits issued. *Environmental Trends* is, in part, the Ministry of Environment, Lands and Parks' response to the Auditor-General's challenge.

The Ministry's *Business Plan 1999–2001* incorporates *Environmental Trends* indicators as measures of progress toward the Ministry's goals. However, it is not possible for any one organization to be solely accountable for the condition of the natural environment. Managing the environment is a collective activity in which all British Columbians are engaged. Improving the quality of the natural environment will require a change in attitude and actions from all elements of society. The publication of this second report signals a commitment on the part of the Ministry of Environment, Lands and Parks to be a leading partner in monitoring the state of the environment, protecting the condition of the environment and improving the quality of the environment.

SUMMARY OF THE INDICATORS

Green Economy
measured as the total and alternative energy consumption (in petajoules)

Protected Areas
measured as the percentage of the land base having protected area status

Domestic Waste
measured as the kg/person/year solid waste generated — proportion disposed of or recycled provided

Air Quality Impacts from Fine Particulates
measured as the percentage of communities exposed to health risks from fine particulates ($PM_{10} > 25\mu g/m^3$) for more than 5% of the time each year

Greenhouse Gases
measured as megatonnes of greenhouse gas emissions in carbon dioxide equivalents

Effects of Global Climate Change
measured as the temperature change (°C) over the past century

Surface Water Quality
measured as ten-year trends of sixty-three water quality monitoring stations

Groundwater
measured as the percentage of groundwater observation wells with declining water levels

Water Use
measured as the cumulative number of stream restrictions by decade

Species at Risk
measured as the percentage of known species threatened or endangered or candidates for these designations (for amphibians, mammals, birds, reptiles, vascular plants and freshwater fish)

Forest Species
measured as the percentage of known forest-dependent species threatened or endangered or candidates for these designations (for amphibians, mammals, birds, reptiles, vascular plants and freshwater fish)

Wildlife
measured as the percentage of historical range that is either no longer occupied or has declining populations for five key species (Caribou, Columbian Sharp-tailed Grouse, Grizzly Bear, Mule/Black-tailed Deer and Moose)

Fish
measured as the percentage of salmon stocks extinct, at high to moderate risk of extinction or of special concern

Riparian Ecosystems on Forest Land
measured as the percentage of riparian area on forest land logged, by watershed grouping

Toxic Contaminants
measured as the concentration of organochlorines (DDE and PCBs) in Great Blue Heron eggs

Highlights

British Columbia is making measurable progress towards achieving both broad goals and specific targets in several areas. Improvements in air and water quality in some communities, aquifer replenishment, and reductions in the concentration of toxic contaminants in "top of the food chain" predators have all been observed.

Improvements have also been made in some of the pressures that British Columbians place on the environment. Reductions in industrial discharges of toxic compounds and per capita domestic waste generation have been achieved. Domestic and industrial stewardship programs have resulted in the diversion of hazardous waste from landfills and incinerators, and many contaminated sites have been remediated.

There are some encouraging signals that environmental markets and activities are becoming increasingly important to the British Columbia economy. Increases have been observed in employment in environmental industries, the number of farms using environmentally friendly technology such as organic agriculture and integrated pest management, and the number of British Columbians choosing recreational activities centred around nature appreciation.

In some cases British Columbians are having a greater impact than ever on natural systems. Greenhouse gas emissions have increased steadily since 1990, per capita domestic water use has remained among the highest in the country, the number of streams believed to be over-allocated or allocated to capacity has more than doubled since 1970, road density on over one-third of the forest land is high enough to have a negative impact on the populations of many large mammals, and not only is energy consumption growing, but the proportion of energy generated from alternative sources is declining.

The poorest performance has been in the protection of natural diversity. A significant percentage of plant and animal species has been identified as threatened or endangered or candidates for these designations, and the range of several wildlife species has decreased.

Those species depending on freshwater habitats are particularly at risk. Populations of some freshwater fish, such as White Sturgeon in the Nechako, Columbia and Kootenay rivers are considered imperilled; many salmon stocks are at high to moderate risk of extinction; 15% of the streams in the Lower Fraser Valley have been lost and an additional 71% are threatened by industrial and residential development not sensitive to environmental values.

The impacts of global climate change on British Columbia are also significant. Temperatures in the interior and the north of the province have increased by two to three times the global average over the past century. The dramatic retreat of glaciers in the province illustrates the significant challenges that global climate change will have for all aspects of environmental protection.

Progress towards achieving legislative, policy and program targets designed to have a long-term impact on the environment has resulted in some positive outcomes. Through the Protected Areas Strategy the government has not only significantly increased the protected areas in the province, but has also ensured that the province's rich ecosystem diversity is better represented in the protected areas network.

Key components of some legislation, designed to protect natural diversity, have not yet been fully implemented. These include parts of the *Forest Practices Code Act*, such as

Landscape Unit Planning, Winter Ungulate Ranges and Identified Wildlife Management Strategy and parts of the *Fish Protection Act*, such as Streamside Directives and the designation of Water Management Areas.

Comparisons

Of particular interest are the comparisons with other jurisdictions. In most areas, British Columbia fares well compared to other places. The percentage of the land base in protected areas is greater than other Canadian jurisdictions and most American and European jurisdictions; toxic releases into the environment are lower than other industrialized provinces in Canada; and the number of extinct or extirpated species compares well with other western North American jurisdictions and is significantly better than jurisdictions in eastern North America.

Although in some cases British Columbians place more pressure on the environment than other jurisdictions (e.g., per capita water use), in other areas British Columbians tread more lightly than others. Per capita carbon dioxide emissions are lower than the Canadian, American and Australian averages and only slightly greater than some European jursidictions such as Germany.

Finally, employment in environmental industries is growing across Canada, and British Columbia is keeping up with this tide.

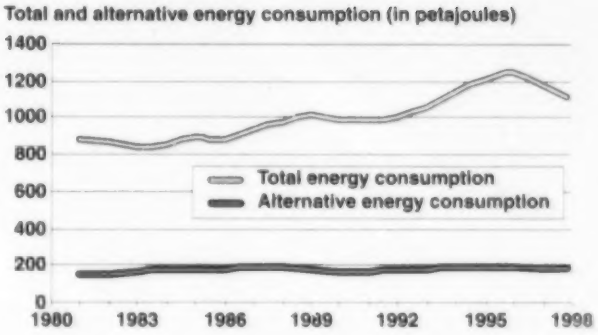
Environmental Trends in British Columbia provides the opportunity to highlight areas where further work is needed and to encourage not only governments but all British Columbians to mobilize resources to improve the conditon of the natural environment.

Indicators at a Glance

Green Economy (page 18)

Total energy consumption in British Columbia increased by one-third between 1981 and 1998. This increase was due to a combination of population and economic growth. The decline in energy consumption between 1996 and 1998 is attributed to a decline in fossil fuel production.

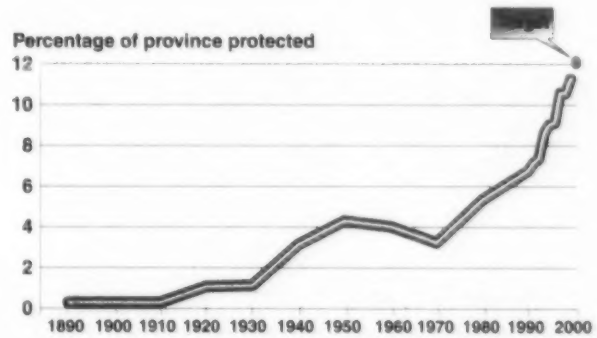
Sixteen percent of the energy consumed in 1998 was generated from alternative sources (i.e., sources that do not deplete natural resources, endanger the environment or compromise the ability of future generations to use the same sources).



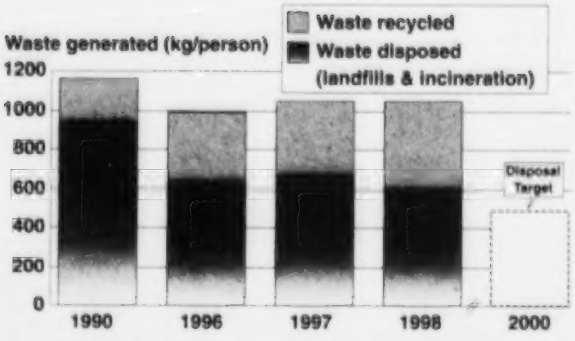
source: Energy Statistics Handbook and CANISM (The Canadian Socio-economic Information Database produced by Statistics Canada), 1999.

Protected Areas (page 20)

The percentage of the province dedicated to protected areas increased from 6.1% in 1991 to 11.4% at the end of 1999. Ecosystem representation has also been improving. More than 30% of the 100 terrestrial ecosections in the province now have greater than 12% of their area in protected areas status.



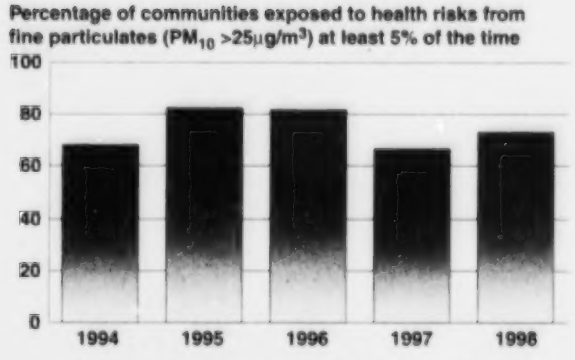
source: British Columbia Land Use Coordination Office, 1999 and BC Parks, 1995.



source: Ministry of Environment, Lands and Parks, 2000. *BC Municipal Solid Waste Tracking Report 1997/98*, Pollution Prevention and Remediation Branch

Domestic Waste (page 22)

Between 1990 and 1998 British Columbians achieved a 36% reduction in the per capita amount of municipal solid waste going to landfills or incinerators. This was largely achieved by an increase in the amount of solid waste being diverted through recycling programs. Waste recycled has increased from 19% of per capita waste generated in 1990 to 42% of per capita waste generated in 1998.



source: Ministry of Environment, Lands and Parks, Air Resources Branch, 2000

Air Quality Impacts from Fine Particulates (page 24)

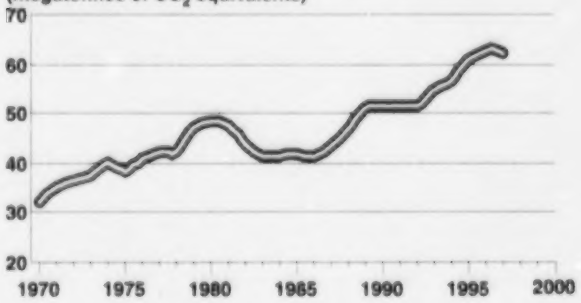
In 1998, 24 out of 33 communites monitored for fine particulates (PM_{10}) exceeded the levels at which health effects are known to occur, more than 5% of the time. Sixteen of these communities exceeded this level more than 10% of the time.

Greenhouse Gases (page 26)

In 1997 total greenhouse gas emission in British Columbia were 61.9 megatonnes of carbon dioxide equivalent, an increase of 21% since 1990. The overall increase since 1990 is largely attributed to increased emissions from transportation.

Between 1996 and 1997 there was a small decline in greenhouse gas emissions, attributable to decreased emissions from fossil fuel production.

Total greenhouse gas emissions in British Columbia (megatonnes of CO_2 equivalents)

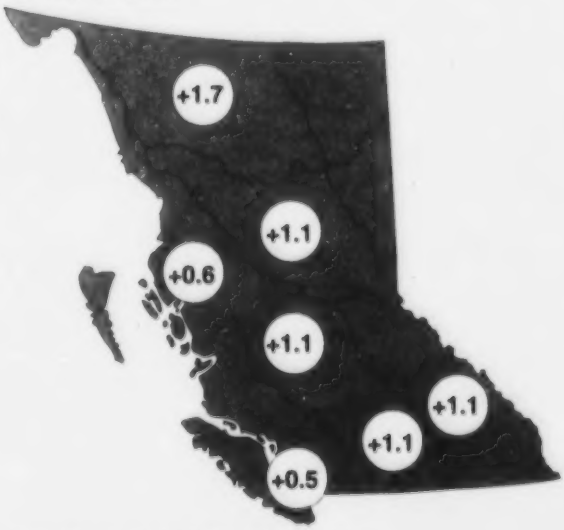


source: Environment Canada, 1999

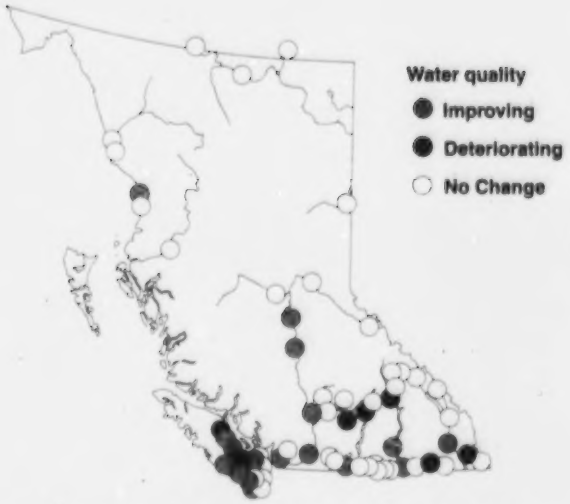
Effects of Global Change (page 28)

British Columbia has experienced a warming trend similar to the rest of the world. Climate change in British Columbia is expected to alter weather patterns with effects that include: more extreme weather events; increased rainfall and decreased snowfall on the coast; altered stream flows resulting in more frequent spring floods; declining fish stocks; and increased frequency of forest fires and pest infestations.

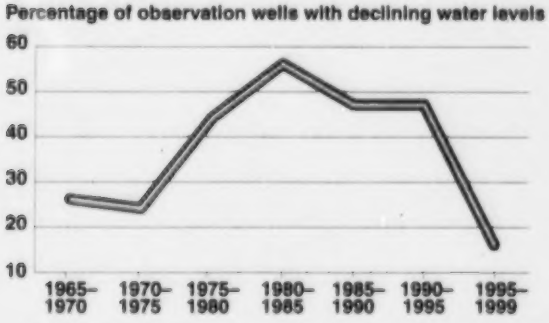
Temperature change (°C) over the past century in British Columbia



source: Canadian Institute for Climate Studies, 1999



source: Ministry of Environment, Lands and Parks, and Environment Canada, 2000. *Water Quality Trends in Selected British Columbia Waterbodies.*



source: Ministry of Environment, Lands and Parks, 1999.

Surface Water Quality (page 30)

In the 10 years between 1985 and 1995, surface water quality in British Columbia remained stable at 60%, improved at 29% and deteriorated at 11% of 63 sampling stations. For the seven stations with deteriorating water quality, the source of problems includes mining discharges, negative impacts of hydro dams on fish and non-point source pollution.

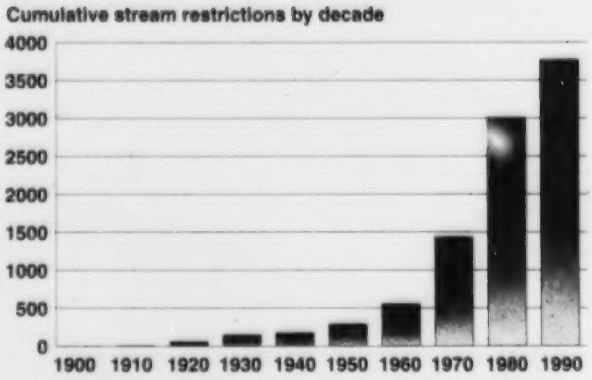
Groundwater (page 32)

The supply of groundwater in most of British Columbia has been increasing over the past ten years, as shown by the decrease in the number of observation wells with declining water levels. This improvement is mainly a result of above normal precipitation.

However, groundwater supply is still considered to be at risk in about 10% of the aquifers that are monitored. These are mainly located on the east coast of Vancouver Island, in the Lower Mainland, and in the Southern Interior. About one-third of the classified aquifers are considered vulnerable to contamination.

Water Use in British Columbia (page 34)

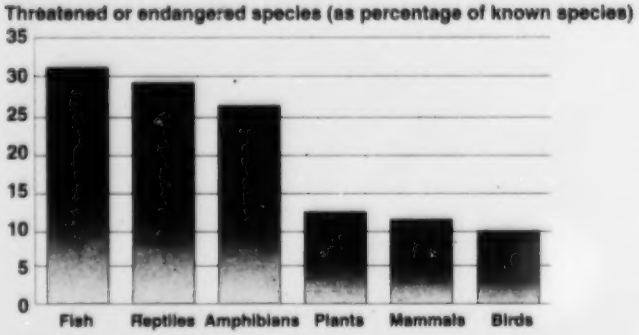
Stream restrictions are used as a management tool to ensure that surface water supply is maintained. The number of streams with stream restrictions totalled over 3500 by the end of 1990. Over the past two decades stream restrictions have increased significantly, indicating an increase in the intensity of water use, pressures on water supply and increased effort in water management.



source: Ministry of Environment, Lands and Parks, 1999.

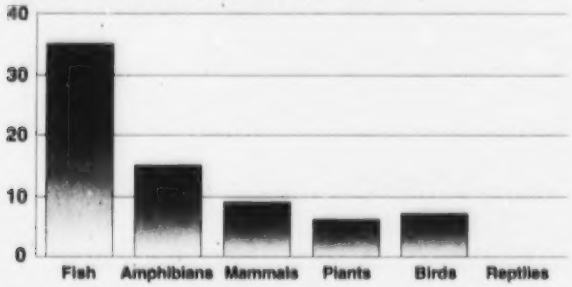
Species at Risk (page 36)

Approximately 12% of vascular plants and 15% of vertebrate animals are listed by the BC Conservation Data Centre as threatened or endangered. Agriculture, urban development and logging pose the greatest threats to species at risk.



source: Ministry of Environment, Lands and Parks, 1999. Conservation Data Centre.

Threatened or endangered forest species (as percentage of known forest species)

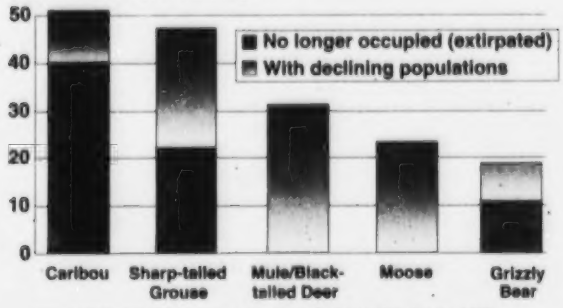


source: Ministry of Environment, Lands and Parks, Conservation Data Centre and State of the Environment Reporting Program, 1999.

Forest Species (page 38)

Fifteen percent of forest-dwelling vertebrates and 6% of forest-dwelling vascular plants are listed by the BC Conservation Data Centre as threatened or endangered. Of particular concern are forest-dependent freshwater fish and amphibians.

Percentage of historical range in which species are extirpated or declining



source: Ministry of Environment, Lands and Parks, Wildlife Branch, 1999.

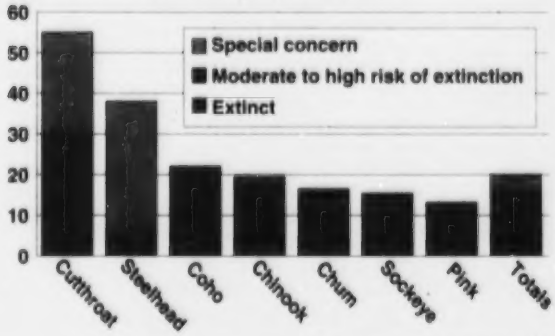
Wildlife (page 42)

The total area occupied by some wildlife species, including Caribou and Columbian Sharp-tailed Grouse has been significantly reduced since the 1950s. Other species, such as Mule/Black-tailed Deer, Moose and Grizzly Bear still occupy over 85% of the area they occupied in 1950.

Fish (page 44)

An analysis of salmonid stocks, conducted in 1996, showed that the status of 43% of the 10,000 salmonid stocks investigated was unknown. Of the 5,476 stocks which could be classified, 3% were extinct, 13% were at moderate to high risk of extinction and 4% were of special concern. Since this analysis was conducted it is likely that more stocks would be considered at risk of extinction.

Percentage of salmonid stocks extinct, at moderate to high risk of extinction or of special concern

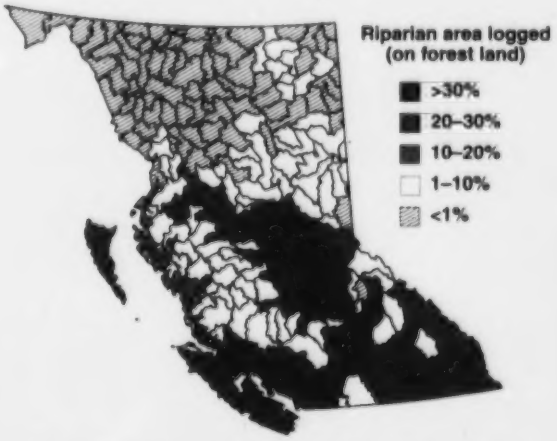


source: T.L. Slaney et al.,1996. *Status of Anadromous Salmon and Trout in British Columbia and Yukon*, Fisheries, V. 21, No. 10, pp. 20–35.

Riparian Ecosystems on Forest Land (page 46)

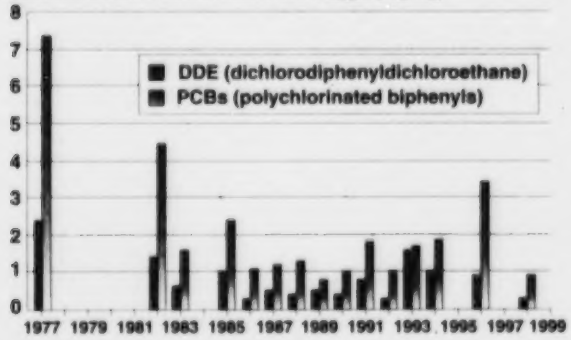
Riparian ecosystems are the transitional areas between aquatic ecosystems and upland forest ecosystems. They contain important habitat used by 88% of native vertebrates in the province. Forest riparian ecosystems also play an important role in stabilizing streambanks, regulating stream temperature, filtering debris and pollutants, and as migration corridors for wildlife.

Prior to the implementation of the Forest Practices Code (FPC) in 1995, it was common practice to log streams to the bank. Since 1995, logging beside large streams has been significantly reduced. However, the removal of vegetation beside small streams is still a problem.



source: Ministry of Environment, Lands and Parks, Geographic Database BC (GDBC), 1999.

Contaminants in Great Blue Heron eggs (mg/kg)



source: Environment Canada, Canadian Wildlife Service, 1999

Toxic Contaminants (page 48)

The level of toxic contaminants found in some wildlife species has been slowly decreasing over the past 20 years. For example, since 1977, PCB levels in the Great Blue Heron colony at University of British Columbia have declined by between 40 and 89%. As well, since 1977 the levels of DDE, a breakdown product of the now banned pesticide DDT have declined by between 40 and 88%.

High altitude areas of the province are particularly vulnerable to contamination by persistent organic pollutants transported long distances by wind.

Developing the Indicators

Development of environmental indicators

The development of meaningful environmental indicators is not an easy task. It is as much an art as it is a science. A set of indicators must be broad enough to represent the main dimensions of the environment, yet be few enough to present an easily understandable picture of environmental quality.

The most effective environmental indicators are:

- representative;
- sensitive to environmental change;
- relevant to public policy;
- easily understood by a non-technical audience.

Recognizing that the development of environmental indicators is in its infancy, the Ministry of Environment, Lands and Parks is putting forward this second set of fifteen key environmental indicators for public discussion.

The government of Canada has made a commitment to develop measurements that integrate economic and environmental well-being. British Columbia will participate in this exercise and include the results of federal work in future reports. More important, though, is the need for continued public discussion and endorsement to encourage widespread adoption of the best indicators and replacement of the weaker indicators with more powerful ones.

Establishing goals

Environmental Trends goes beyond a simple presentation of scientific information to provide a measurement of progress towards attaining environmental goals.

MINISTRY GOALS

Natural Diversity

Protection, conservation and restoration of a full range of biological and physical diversity native to British Columbia.

Healthy and Safe Land, Water and Air

Clean, healthy and safe land, water and air for all living things.

Sustainable Social, Economic and Recreational Benefits

Provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment.

Responsive and Adaptive Organization

Supporting innovative and responsive ministry programs and staff who seek the best results and service for the public.

The goals articulated for each environmental indicator were established by the Ministry of Environment, Lands and Parks as part of the business planning process, and are intended to provide direction for managing the environment. They were established with a sensitivity to public opinion and are meant to reflect the direction needed to achieve a clean, healthy and naturally diverse environment for present and future generations. Although these broad goals have been set by government, they cannot be achieved without the full participation of British Columbia's citizens, communities and industries.

Setting targets

In many cases, specific and quantifiable targets have been set to guide the province towards achievement of broad goals. In some cases, targets have been set by the provincial government. These targets provide milestones by which the province can gauge its progress in protecting the environment. An example of a target set in this way is the target for waste reduction: 50% reduction in the amount of waste going to landfills or incinerators by 2000. In other cases, British Columbia has adopted targets set by external processes, such as national and international agreements. An example of a target set in this way is the target for protected areas: protect 12% of the land base of the province by 2000. This target was suggested by the World Commission on Environment and Development in their 1987 report, *Our Common Future*.

International Obligations

As environmental problems become more global, and economies become more interconnected, the rules under which the environment is managed are increasingly being negotiated through international agreements. By 1997, Canada had signed over 230 international environment agreements, of which 50 are directly relevant to British Columbia. These include :

- Convention on Biological Diversity (1992);
- Agenda 21 (1992);
- International Panel on Forest Recommendations (1998);
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (1997);
- UNESCO World Heritage Convention (1979).

In addition, British Columbia has signed dozens of international intergovernmental agreements on wildlife, environmental cooperation and information exchange since the 1960s.

British Columbia is the most biologically diverse region in Canada. As such it plays a key role in the implemention of many of Canada's international agreements, including the preservation of areas of world importance.

Three of Canada's 12 World Heritage Sites are in British Columbia:

- SGaang Gwaii is fully within British Columbia;
- Kluane/Wrangell-St. Elias/Glacier Bay/ Tatshenshini-Alsek straddles the British Columbia/Alaska/Yukon border;
- Canadian Rocky Mountain Parks is in British Columbia and Alberta.

As well, British Columbia has designated two wetland sites, Alaksen and Creston Valley, to the Ramsar Convention, an international convention designed to protect wetlands of international importance as waterfowl habitats. These two wetland sites represent about 6% of the total Ramsar land in Canada's 36 sites.

In addition to the ongoing legacy of internationally designated lands, British Columbia's programs and people are recipients of international awards, including, in 1999, the Pacific Estuary Conservation Program (PECP), which won the Ramsar award for its work to protect British Columbia's wetlands.

Some international environment agreements include provisions relating to indigenous people. Through the British Columbia Treaty Settlement process, the provincial government and First Nations people are developing ways of incorporating traditional knowledge into environmental decision-making.

Next Steps

Environmental Trends in British Columbia, 2000 will stimulate discussion and provide the impetus for action on several fronts. As a first step, the best environmental indicators will continue to be updated regularly, so that they become a familiar tool for incorporation into everyday decision-making.

The legislative and policy framework is now in place to address some of the environmental problems that have been identified by these fifteen indicators. Systematic and vigilant environmental monitoring and auditing, coupled with compliance strategies, are now required to ensure compliance with legislation and the achievement of desired environmental results.

The Ministry of Environment, Lands and Parks is currently developing a compliance strategy to improve on the delivery of legislation, regulations and policy, and to ensure that a full range of effective compliance tools are being used. The challenge will be to ensure that adequate resources are directed to a timely and effective implementation of the compliance strategy.

Monitoring, inventories and research are at the very foundation of environmental management and any environmental indicators report. The number of communities being monitored for air quality has improved slightly over the past four years, whereas the number of water bodies monitored for water quality has declined significantly.

In the past few years Forest Renewal BC has provided significant funds for inventories of community watersheds, forest-dwelling species, fish populations and critical habitats. As well, tools such as the Watershed Ranking Tool, have been developed to make better use of inventory information in decision-making. Inventories of wildlife species and habitat will need to continue to provide a credible information base for managing the environment.

Monitoring and inventories are essential but costly. Through the process of public discussion and stewardship initiatives, strategic partnerships will need to be forged to ensure that the costs of monitoring and inventories are shared and that the opportunities for better management through the use of monitoring and inventory information are not lost.

Through treaty negotiations First Nations throughout the province will become more involved in the management of wildlife on treaty lands. New challenges to the implementation of a more integrated, ecosystem-based approach to wildlife management will be posed, as the responsibilities for wildlife are shared among more partners.

Public pressure, both in British Columbia and outside, is changing the way BC companies do business. Once example is the demand for independent, "environmentally friendly" certification of forest products. The Ministries of Environment, Lands and Parks and Forests are currently examining government policies to ensure that barriers to independent certification are removed.

Maintaining a healthy, diverse environment will require actions to be taken by all British Columbians. Governments can provide incentives for a stewardship ethic, but they cannot force the growing population to live more sustainably—to drive their cars less; to buy less toxic products; and to generate less garbage.

The Indicators

The fifteen key indicators are presented on the following pages. Each indicator is presented on two pages. The first page contains a graph depicting the indicator, as well as information on status and trends, importance and actions being taken. The second page discusses "secondary measures," which provide a more detailed look at the issue. Where feasible, secondary measures focus on three areas:

- a sub-regional picture of the issue, with the province divided into ecological units based on *Ecoregions of British Columbia* or the *Watershed Atlas of British Columbia*;
- a summary of sources of problems or threats;
- a comparison with other jurisdictions.

The choice of indicators involved consultation with groups of experts for each issue. Many of the indicators reflect current indicators being used regionally (i.e., Pacific Northwest), nationally or internationally. Other indicators are of specific interest to British Columbia. Together, the fifteen indicators represent a balance between provincial, national and global issues.

Categorizing the indicators

Categorizing the indicators is challenging. The most effective indicators often defy categorization because they cross media or issue boundaries. For simplicity of presentation, the indicators have been grouped into five categories: land, air, water, natural diversity and ecosystem health.

There are three land indicators — green economy, protected areas and domestic waste; three air indicators — fine particulates, greenhouse gases and global climate change; three water indicators — surface water quality, groundwater and water use; four natural diversity indicators — species at risk, forest species at risk, wildlife populations and fish; and two ecosystem health indicators — riparian ecosystems on forest land and toxic contaminants in biota.

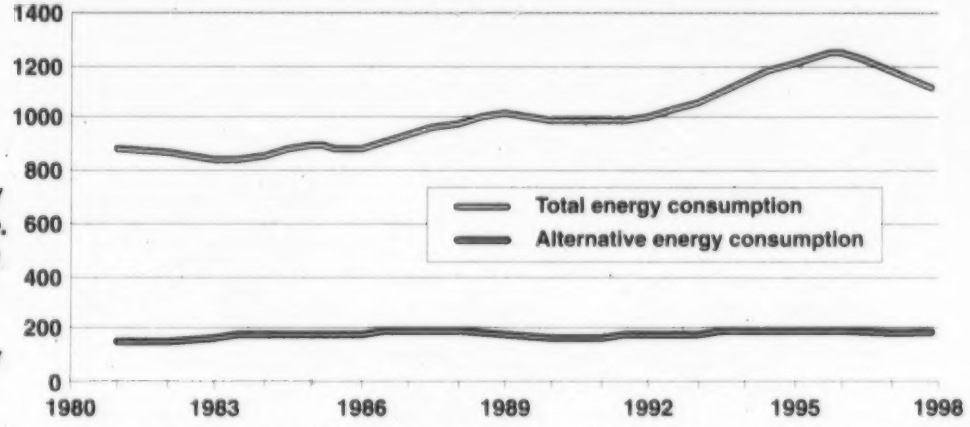
Future indicator development

This set of fifteen indicators reflects, to a large extent, the availability of reliable environmental data sets. Since the publication of *Environmental Trends in British Columbia, 1998*, considerable improvements have been made in the accessibility and usability of geographic information systems (GIS). Riparian Ecosystems on Forest Land is an example of an indicator that could not have been developed without this new technology. Future indicator development will keep step with the availability of new data sets in GIS format.

In addition, issue areas such as compliance and enforcement, will be added to future reports.

Green Economy in British Columbia

Total and alternative energy consumption (in petajoules)



source: Energy Statistics Handbook and CANISM (The Canadian Socio-economic Information Database produced by Statistics Canada) 1999

Developing alternative energy is labour intensive. Studies show that a million dollars invested in alternative energy will produce in excess of 50% more jobs than an equivalent investment in conventional energy development.

Status and trends in energy consumption

- From 1981 to 1998 the total amount of energy used in British Columbia increased by one-third. The increase was due to a combination of population and economic growth.
- The decline in energy consumption from 1996 to 1998 was the result of a decrease in fossil fuel production.
- British Columbia's economy has become more energy efficient over the past 17 years. That is, it took less energy to produce the same dollar value of a good or service in 1998 than it did in 1981.
- Alternative energy, or energy that does not deplete natural resources, endanger the environment or compromise the ability of future generations to use the same energy sources, is a significant component of the environmental or green industry sector.
- In 1998, 16% of the energy consumed in British Columbia was derived from alternative energy sources. These include biomass (primarily wood waste and other biological matter), solar, wind, micro-hydro and fuel cells.
- Large hydroelectric projects are not included as an alternative energy source because the flooding of lands or watersheds required by large reservoirs can have negative impacts on the environment.

Per capita energy consumption has not changed significantly in the last 20 years, but remains among the highest in the world (along with the rest of Canada).

Why is it important?

- The production, transportation, transmission, and use of conventional energy all have impacts on the environment, including the emission of greenhouse gases and atmospheric pollutants through the combustion of fossil fuels. These impacts can be reduced by decreasing energy consumption, by using energy more efficiently and by developing alternative energy sources that are less stressful on the environment.
- The most environmentally benign alternative energy technologies are solar, wind and micro-hydro (river, tidal, wave).
- Solar, wind, wave and tidal energy account for only 0.02% of electricity generation in Canada.

What is being done?

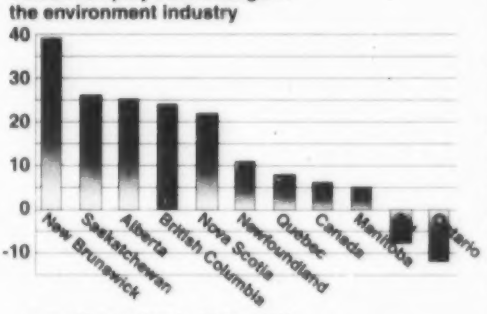
- The government of British Columbia is developing and implementing a Green Economy Initiative in partnership with other agencies, focusing on renewable energy, environmental industry, ecotourism and tax shift reform.
- The first pilot tax-shift project is underway. It encourages the closure of beehive burners and the development of alternative uses for wood waste, such as ethanol production.
- Since the 1980s utility corporations in British Columbia have mounted an intensive campaign to encourage energy conservation.

BRITISH COLUMBIA'S GOAL: *Provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment.*

What are the employment trends for environmental industries?

- From 1995 to 1997 (the only years for which statistics are currently available) BC had a 24% increase in employment in the environment industry sector resulting in the creation of over 5,700 jobs during this three-year period.
- The environment industry sector is one of the fastest growing sectors of the BC economy. In 1997 it generated over $1.2 billion in revenues and employed 23,500 people.
- BC's environment industry is a diversified, high technology sector of the economy that encompasses a broad range of market segments including: water and wastewater treatment, eco-efficiency, alternative energy and fuels, air emissions control, solid and hazardous waste management, materials recovery, measurement, instrumentation and remediation.

Percent employment change in the environment industry



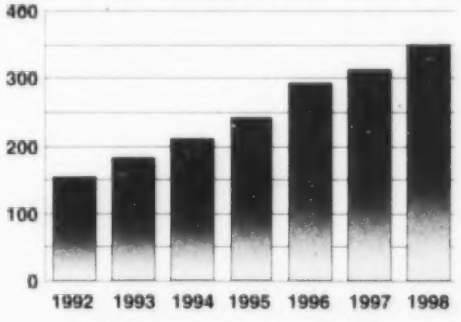
SOURCE: Statistics Canada, 1998 and 1999.
NOTES: The Environment Industry represents all companies operating in BC that are involved in whole or in part in the production of environmental goods, the provision of environmental services and the undertaking of environment-related construction activity. The total number of jobs in each province for 1997 was: New Brunswick 3,957; Saskatchewan 3,176; Alberta 22,499; British Columbia 23,524; Nova Scotia 3,989; Newfoundland 1,835; Quebec 32,748; Canada 159,932; Manitoba 4,924; Prince Edward Island 316; and Ontario 62,620.

The Globe Foundation identified the top two forces influencing growth in environmental industries as the enforcement of current environmental standards and the development of new standards.

Is agriculture becoming more environmentally friendly?

- Organic agriculture is a low energy-input method of farming that largely prohibits the use of synthetic fertilizers, pesticides, feed additives or genetically modified organisms.
- The number of certified organic producers and processors in British Columbia more than doubled between 1992 and 1998.
- The total area in organic production increased from 10,600 acres in 1997 to 28,500 acres in 1999. This represents only one half of a percent of the total agricultural land area in British Columbia.
- Integrated Pest Management (IPM), also aimed at reducing synthetic pesticides, combines a variety of chemical, biological, cultural and genetic methods to control pests in an environmentally sound way.
- Recent changes to the BC *Pesticide Control Act* encourage pesticide users to adopt IPM practices.

Number of certified organic producers and processors



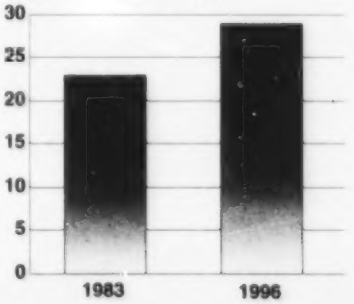
SOURCE: Canadian Organic Growers Association, 1999.

Organic agriculture occurs on 0.5% of the agricultural land in British Columbia.

How important is direct wildlife activity to British Columbians?

- Direct wildlife activities are trips away from home where the main purpose is to watch, photograph or study wildlife.
- In 1996, almost 864,000 provincial residents, or 29% of the adult population, participated in direct wildlife activities. This represents an increase from 23% since 1983.
- Participation in direct wildlife activities is higher outside the Lower Mainland and Okanagan. For example, in the Northwest of the province, 34% of the population participated in direct wildlife activities.

Percentage of BC residents participating in direct wildlife activity

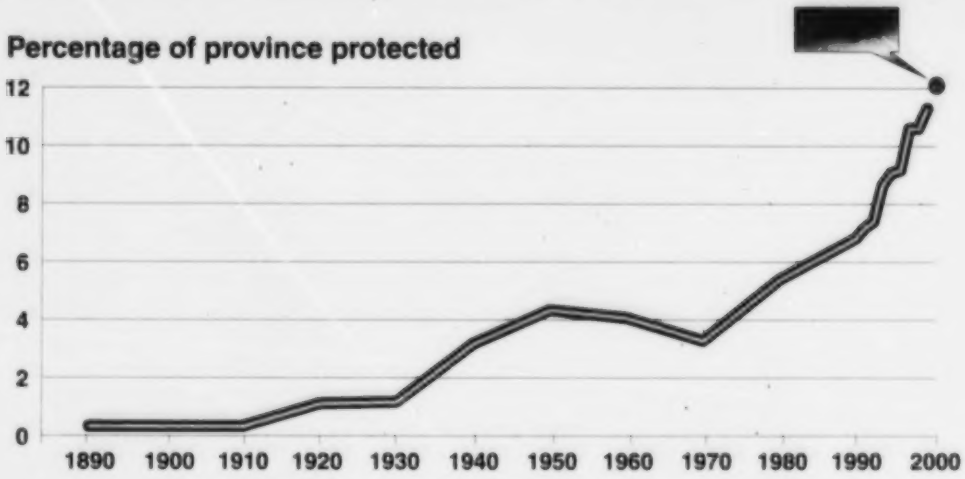


SOURCE: BC Ministry of Environment, Lands and Parks, Wildlife Program, 1985 and 1998.

The economic value of direct wildlife activities was estimated at over $790 million in 1996.

Protected Areas in British Columbia

Percentage of province protected



source: BC Land Use Coordination Office, 1999, and BC Parks, 1995. notes: Data for this graph were compiled by decade until 1990, and do not reflect annual trends. Protected areas include those which have been designated and those announced but are not yet designated under the *Park Act*, *Ecological Reserve Act* or other protected areas legislation.

British Columbia is well on the way towards achieving its goal of dedicating 12% of its land base to protected area status in 2000.

British Columbia is Canada's most biologically diverse province.

7% of protected areas in British Columbia are larger than 10,000 hectares. These include recently protected areas such as Pine LeMoray, Stein Valley Nlaka'pamux, Itcha Ilgachuz, Northern Rocky Mountain, Graham–Laurier, Liard River Corridor, and significantly expanded parks such as Carmanah Walbran, Kakwa and Brooks Peninsula.

Status and trends of protected areas

- In 1991, approximately 6.1% (5.74 million hectares) of the land base of British Columbia was dedicated to protected areas; by the end of 1999, approximately 11.4% (10.77 million hectares) was dedicated to protected areas.
- In British Columbia, protected areas include national parks, ecological reserves, class A and C parks, recreation areas and protected areas that fall under the *Environment and Land Use Act*. They do not include wildlife reserves, migratory bird sanctuaries and regional parks.
- In the late 1930s and 1940s, park expansion was used to encourage tourism; in the 1950s and '60s, the area with protected areas status was reduced by 1 million hectares; in the 1970s and '80s park creation began to focus on protection of unique natural environments; in the 1990s representation of British Columbia's biological and cultural diversity, recreational resources and habitat protection have become primary objectives.
- In 1999, over 24 million visits were made to provincial parks in British Columbia. This represents a small decrease since the 1998 high of 26 million visits.

Why is it important?

- In British Columbia, protected areas are one key element of a strategy to protect the province's biological and cultural heritage.
- The protected areas network also provides outdoor recreational opportunities.
- Protected areas have become an important component of land use planning, contributing to the maintenance of ecosystems, species and genetic resources.

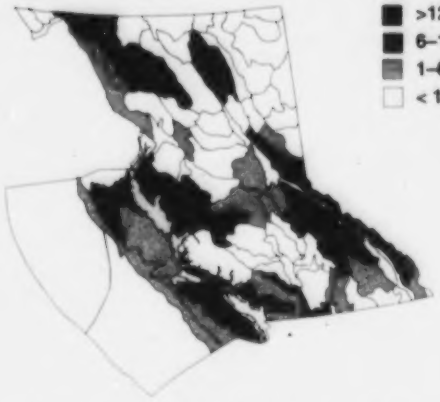
What is being done?

- Since 1992, the Protected Areas Strategy has ensured that strong regional and sectoral input from land use planning processes is a critical part of identifying new areas to protect.
- The government is currently developing proposals to respond to BC's Park Legacy Panel. The purpose of these is to strengthen ecological stewardship and increase community ties to protected areas.
- The Marine Protected Areas Strategy, a partnership between the governments of Canada and British Columbia, was initiated to establish a system of marine and coastal protected areas, through planning and public consultation, by the year 2010.

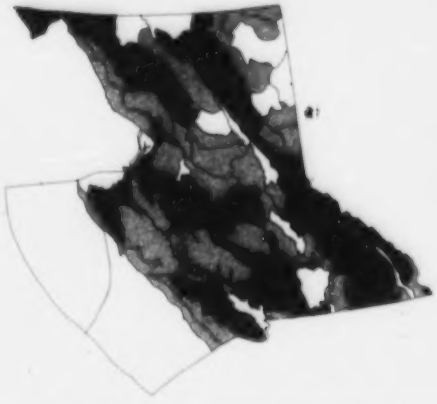
BRITISH COLUMBIA'S GOALS: *Protection, conservation and restoration of a full range of biological and physical diversity native to British Columbia, and provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment. As part of the attainment of these goals, the province has set a target to protect 12% of the land base (11.35 million hectares) in the year 2000.*

Is British Columbia's rich ecosystem diversity protected?

Percentage protected 1991



Percentage protected 1999



Eleven newly protected areas in the Muskwa-Kechika have resulted in a significant increase in protected areas in northern British Columbia.

source: BC Land Use Coordination Office, 1999. notes: The delineations represent ecosections, as described in *Ecoregions of British Columbia*, D. Demarchi, 1993, except for the 12 marine ecosections, which are found in *The Marine Ecoregions of British Columbia*, D.E. Howes, M. A. Zacharias and J.R. Harper, 1996.

- An ecological classification system divides British Columbia into 112 ecosections, representing different ecosystem types. Twelve of these are predominantly marine.
- One objective of the Protected Areas Strategy is to increase the protection of ecosystem diversity. The amount protected will vary within each ecosection.
- Since 1991, significant progress has been made in improving ecosystem representation in the protected areas system (see table).
- Marine ecosystems are poorly represented. Only 1.2% of marine ecosections in British Columbia are in protected areas status.

Percentage of terrestrial ecosections in protected area status		
	1991	1999
less than 1%	53	16
1–6%	19	31
6–12%	12	21
greater than 12%	16	32

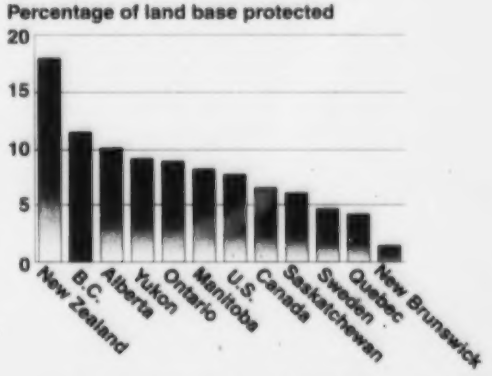
- Significant increases in the extent of ecosystem representation have occurred in the Northern Rockies (Muskwa-Kechika), Northwest (Tatshenshini-Alsek), Central Interior (Ts'yl,-os), Southern Interior (Lac du Bois) and on Vancouver Island (Carmanah Walbran).

Ecosystem representation in British Columbia has been improving since 1991. Over 50% of terrestrial ecosections now have greater than 6% of their area dedicated to protected area status.

How does British Columbia compare to other places?

- British Columbia has the highest percentage of land base protected in Canada.
- For an area to be included in this analysis it must be exempted from any type of resource extraction or human manipulation that would cause long-term or large-scale impacts on its natural character. Exempted activities include logging, mining, the development of hydroelectric dams and oil or gas extraction.
- Protected areas must also be permanent to be included in this analysis. This usually means they are formally designated under legislation or under interim planning measures such as completed Land and Resource Management Plans.

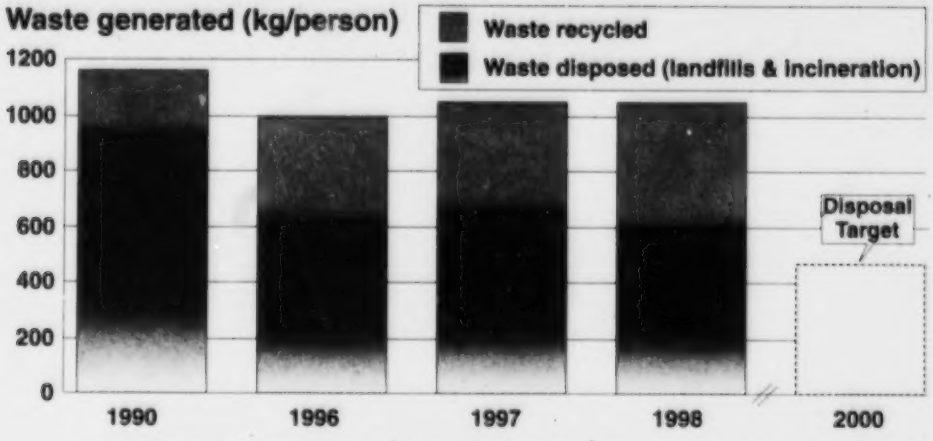
Percentage of land base protected



source: Canadian numbers: World Wildlife Fund, 1999. *Endangered Spaces, Progress Report on Protecting Canada's Wild Lands*, accurate to the end of March 1999. International numbers: World Conservation Union (IUCN), 1998. *1997 United Nations List of Protected Areas*, accurate to the end of 1996. notes: International analysis includes only IUCN categories I-III. Percentages for New Zealand, Sweden and the United States do not include protected areas under 1,000 hectares in size. Percentages for Canadian jurisdictions include all protected areas regardless of size.

In 1994 Canada and 167 other countries signed the Convention on Biological Diversity. One component of this agreement is to establish a network of protected areas to conserve biodiversity.

Domestic Waste in British Columbia



source: BC Ministry of Environment, Lands and Parks, 2000. Pollution Prevention and Remediation Branch. *BC Municipal Solid Waste Tracking Report 1997–98*. notes: Estimates for recycled and disposed wastes were derived from municipal surveys conducted across British Columbia. Although participation in these surveys has increased in recent years, not all municipalities are represented. Survey methodology was improved in 1996, increasing the reliability of the data. Estimates of recycled waste are likely underestimated as private recycling facilities and recyclables collected by industry stewardship agencies are not included.

Status and trends of solid waste

Between 1990 and 1998, British Columbians achieved a 36% reduction in the per capita amount of municipal solid waste going to landfills or incinerators.

- It is estimated that British Columbians generated 1,050 kg of solid waste per person in 1998. Of this, 607 kg was disposed to landfills and incinerators. This represents a 36% reduction in waste disposed per person, between 1990 and 1998.
- In 1998, 443 kg of solid waste per person was diverted from landfills and incinerators for recycling. Waste recycled has increased from 19% of waste generated in 1990, to 42% in 1998.
- The total amount of waste disposed to landfills and incinerators decreased from 2.9 million tonnes in 1990 to 2.4 million tonnes in 1998. This decrease in waste disposed was achieved despite a population increase of 22% for the same time period.
- Ninety-two percent of British Columbia's disposed waste is sent to landfills; the remaining 8% is incinerated.

Why is it important?

- A large percentage of British Columbia's waste represents lost resources. In recognition of this, British Columbia is committed to reducing, reusing and recycling waste to save resources.
- Landfills consume valuable land, are a significant source of greenhouse gases and can contribute to groundwater contamination and air pollution. These factors make landfills unappealing to most communities and the task of finding new landfill sites very difficult.
- Although modern incinerators produce much lower levels of pollutants than older incinerators, they still emit acid gases, carbon dioxide, toxic chemicals and fine particulates.

What is being done?

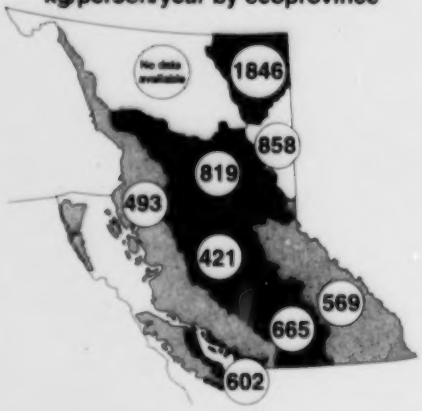
- Domestic and industry stewardship programs, coupled with government programs, are ensuring that the most hazardous components of solid waste are disposed of safely. The existing programs (date initiated) include: lead-acid batteries and scrap tires (1991); used lubricating oil (1992); paint residuals (1994); pharmaceuticals, solvents, flammables, pesticides and gasoline residuals (1997); and beverage containers (1998).

BRITISH COLUMBIA'S GOAL: *Clean, healthy and safe land, water and air for all living things. As part of the attainment of these goals, the province has set a target to reduce the amount of solid waste disposed to landfills or incinerators by 50% of the 1990 per capita disposal rate by 2000 year-end.*

Where is the most waste generated in British Columbia?

- From 1990 to 1998, the annual per capita disposal rates have decreased in the Georgia Depression and Southern Interior by 33%, Coast and Mountains by 39%, Southern Interior Mountains by 19% and Central Interior by 18%.
- The Capital (CRD) and the Greater Vancouver (GVRD) regional districts, together generate 70% of the waste in the province as a result of their high populations. These regions are also leaders in diversion programs. Both districts have extensive recycling programs, charge landfill tipping fees and have prohibited several materials, such as paper, from being disposed of in landfills.

Waste disposed kg/person/year by ecoprovince

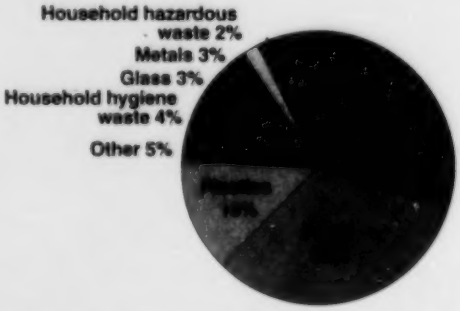


SOURCE: BC Ministry of Environment, Lands and Parks, 2000. State of the Environment Reporting Program, Corporate Policy Branch. NOTES: The delineations on the map show the 10 ecoprovinces, based on *Ecoregions of British Columbia*, 1993.

The high cost of transportation, associated with the long distance to markets, has made it difficult for northern communities to incorporate recycling into waste management programs.

What is the composition of waste going to landfills?

- Although the exact composition of waste differs from region to region, paper and organics make up most of the waste disposed to landfills and incinerators throughout the province.
- Material banned from the GVRD landfills, such as lead-acid batteries, tires, waste gypsum and wallboard, comprise 16% of recycled materials.
- In 1998, over 96,300 tonnes of organic matter was diverted from landfills in the GVRD, as a result of residential backyard composting and municipal collection of yard trimmings.



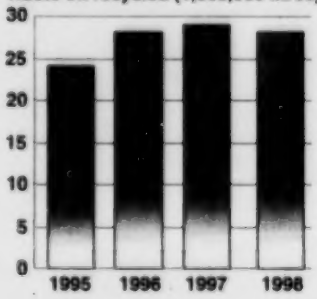
SOURCE: Greater Vancouver Regional District, 1999. Solid Waste Operations.

Significant amounts of reusable and recyclable materials are still disposed of in landfills and incinerators.

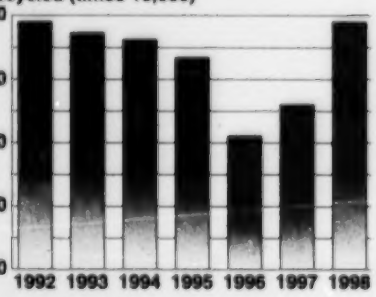
What are the results of consumer and industrial product stewardship programs?

- Product stewardship initiatives involve industry and consumers taking responsibility for waste from the products they produce or use.
- In 1998, 56% of the estimated 50 million litres of lubricating oil available for recovery from domestic and industrial users was recycled.
- The polyaromatic hydrocarbons (PAHs) and heavy metals found in lubricating oil are toxic to plants and animals at low concentrations and can restrict plant physiology at higher concentrations.
- In 1998, 780,000 lead-acid batteries were recycled in British Columbia. Lead-acid batteries disintegrate in landfills, releasing lead into the environment. Lead accumulation in body tissue is toxic.

Waste oil recycled (1,000,000 litres)



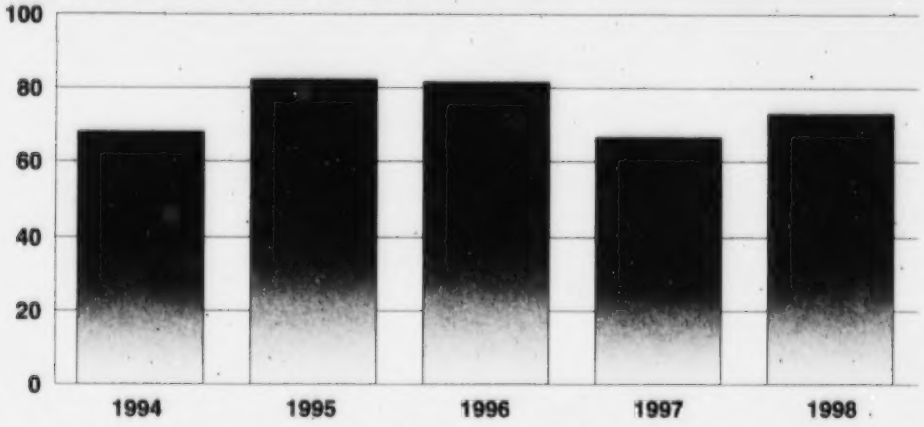
Number of lead-acid battery units recycled (times 10,000)



SOURCE: BC Ministry of Environment, Lands and Parks, 1999. Pollution Prevention and Remediation Branch. NOTES: Waste oil was received at Mohawk's North Vancouver Re-refinery. The BC Lead-Acid Battery Collection Program was implemented by the Ministry of Environment, Lands and Parks in June 1991.

Air Quality Impacts from Fine Particulates

Percentage of communities exposed to health risks from fine particulates (PM_{10} >25μg/m³) at least 5% of the time



source: BC Ministry of Environment, Lands and Parks, 2000, Air Resources Branch. notes: This indicator depicts the percentage of sampling stations where PM_{10} is greater than 25 micrograms/m³, the concentration above which health risks begin to occur, for more than 5% of the time in each year. Data were taken from two types of sampling stations — continuous and non-continous. Non-continuous samplers take samples once every six days. Only stations with data for 75% of the hours in at least 11 months of the year were included. The total number of stations meeting these requirements were: 1994, 19; 1995, 23; 1996, 27; 1997, 30; 1998, 33. Monitoring sites are often present in comminities where air quality is a concern, therefore the data do not necessarily reflect the average air quality in BC.

Every year since 1994 more than half of the air quality monitoring stations have reported levels of PM_{10} in the range where effects on health have been reported.

Status and trends in fine particulates

- In 1998, 24 out of 33 communities monitored exceeded the fine particulate (or PM_{10}) levels at which health effects are known to occur, more than 5% of the time. Sixteen of these communities exceeded this level more than 10% of the time.
- Particulate matter (PM) includes solid and liquid particles, such as dust, dirt, soot, smoke and liquid droplets, directly emitted into the air by sources such as factories, power plants, cars, construction activity, fires and naturally windblown dust.
- Particulate matter can also be formed in the air from the chemical transformation of directly emitted gases such as sulphur dioxide, nitrogen oxides and various hydrocarbons and ammonia.
- PM is divided into classes depending on size. In general, the smaller sized particles pose the greatest health risk. PM_{10}, measured in this report, refers to particles 10 micrometres or less (about one-eighth the width of a human hair).
- Recent scientific investigations have shown that $PM_{2.5}$, particles 2.5 micrometres or less, poses the greatest health risk. $PM_{2.5}$ is a subset of PM_{10}. As data become available, future indicators will report on $PM_{2.5}$.

Why is it important?

- Fine particulates (both PM_{10} and $PM_{2.5}$) can pose a serious threat to public health. They can affect breathing, aggravate existing respiratory and cardiovascular disease, alter the body's defence systems and damage lung tissue, contributing to cancer and premature death.
- As a major component of "smog," $PM_{2.5}$ contributes to reduced visibility, which leads to negative impacts on safety, aesthetics, business and tourism.

What is being done?

- British Columbia has initiated several programs and activities to improve air quality. These include: the development of air quality management plans in Prince George, the Bulkley Valley, Greater Vancouver Regional District, Quesnel/Williams Lake and Fraser Valley Regional Districts; AirCare, an ongoing activity to reduce motor vehicle emissions in the Lower Fraser Valley (LFV); a heavy vehicle testing program in the LFV; modernization of air monitoring programs; continued phase-out of beehive burners; and Smoke Control Regulations such as the regulation of large-scale open burning and higher standards for wood stoves.

BRITISH COLUMBIA'S GOALS: *Clean, healthy and safe land, water and air for all living things, and provision of social, economic and outdoor recreation opportunities consistent with maintaining a naturally diverse and healthy environment.*

Where are the risks to health from fine particulates?

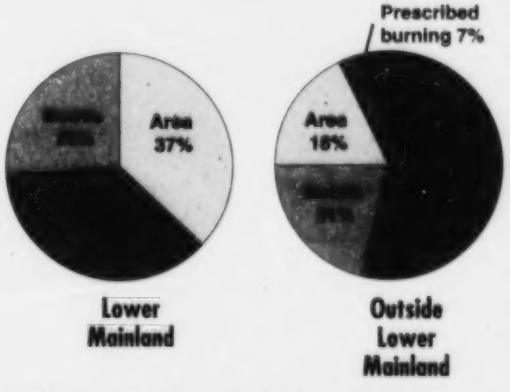
- Recent scientific evidence indicates that negative health effects from PM_{10} can occur when outdoor concentrations rise above 25 micrograms per cubic metre.
- Most at risk are individuals with chronic obstructive pulmonary or cardiovascular disease, asthmatics, the elderly and children.
- Concentrations of air pollutants, such as fine particulate matter, can vary greatly among communities that are fairly close together. Topography, air circulation patterns, settlement patterns and the location of industries all affect the concentrations of fine particulate matter in local airsheds.
- Communities in the southwest of BC, including Vancouver Island, were exposed to health risks from fine particulates 2 to 12% of the time in 1998. Communities in the rest of the province were exposed to health risks from fine particulates 6 to 61% of the time.

Communities in the interior of the province are exposed to high concentrations of PM_{10} more often than communities in the more populated southern areas.

source: BC Ministry of Environment, Lands and Parks, 1999. Air Data and Monitoring System Database. NOTES: The dark portion of the pie graphs shows the percentage of time in 1998, at each sampling station, that PM_{10} exceeded 25 micrograms/m^3, i.e., levels above which health effects can occur. The green pies represent data taken from continuous samplers and the grey pies represent data taken from non-continuous samplers, (i.e., one sample every six days). The delineations on the map show the 10 ecoprovinces of British Columbia, based on *Ecoregions of British Columbia, 1993*.

What are the sources of fine particulates?

- In the Lower Mainland, point sources (i.e., emissions for which permits have been issued) account for 37% of PM_{10} emissions — 14% originates from bulk shipping terminals and 10% from the processing of forest products. Area sources (i.e., small business and residential) account for 37% of PM_{10} — 18% originates from agriculture. Mobile sources, from cars and other modes of transportation, account for 26% of PM_{10} emissions.
- Outside the Lower Mainland, point sources account for 54% of PM_{10} emissions — 41% originates from the processing of forest products, including beehive burners and pulp and paper processing. Area sources account for 18% of the total — 11% from residential wood heating and 4% from agricultural wind erosion. Mobile sources contribute 21% of the total.
- Secondary particulates, formed by chemical reactions among pollutants in the atmosphere, are not captured by emission data, but do add significant quantities of PM_{10} to the atmosphere. Secondary particulates are considered a major air quality concern in the Lower Mainland.

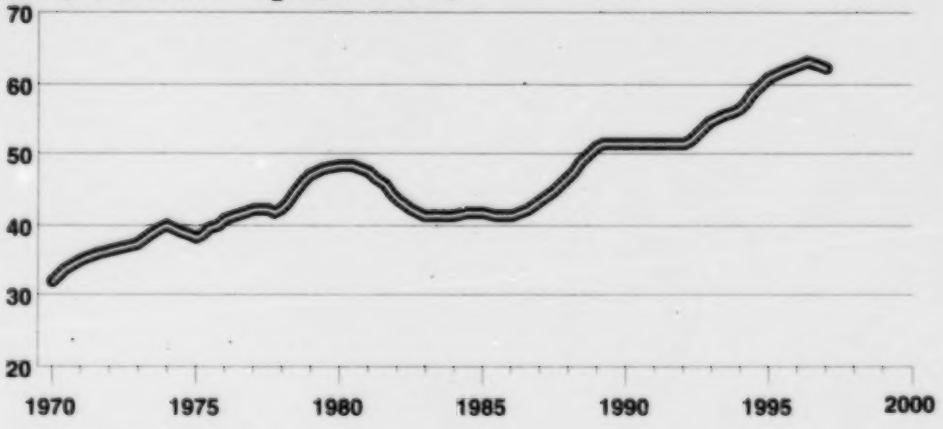


Outside the Lower Mainland, the contribution of prescribed burning to total PM_{10} emissions has been reduced from 21,600 tonnes in 1990 to 8,900 tonnes in 1998.

source: BC Ministry of Environment, Lands and Parks, 2000, Air Resources Branch. NOTES: The Lower Mainland is commonly referred to as the Lower Fraser Valley and includes the Greater Vancouver Regional District (GVRD). A complete listing of emissions data for the Lower Mainland can be found in "1998 Emission Inventory for the Lower Fraser Valley Airshed." The sources represented here do not include road dust or natural sources such as wildfires and marine aerosols. The contribution of road dust to PM_{10} is difficult to estimate accurately. However, it is generally believed that in some locations, road dust can add significant quantities of PM_{10} to the air.

Greenhouse Gases in British Columbia

Total greenhouse gas emissions in British Columbia (megatonnes of CO_2 equivalents)



Source: Environment Canada, 1999

In 1997 British Columbia contributed 9.1% of Canada's total greenhouse gas emissions, up from 8.5% in 1990.

Status and trends in greenhouse gas emissions

- In 1997 total greenhouse gas (GHG) emissions were 61.9 megatonnes of carbon dioxide equivalent, an increase of 30 megatonnes or 94% since 1970. Since 1990 there has been a 10.7 megatonne, or 21%, increase.
- Per capita GHG emissions increased by 0.1% between 1990 and 1997, indicating that population growth has had a major impact on total GHG emissions. Between 1970 and 1997, the population in British Columbia increased by 90%, from 2.1 million to 4 million. From 1990 to 1997 population increased by 20%.
- If current trends continue, between 1990 and 2010 British Columbia's GHG emissions are expected to increase by 38%. This represents one of the largest expected increases in Canada, exceeded only by Alberta and Saskatchewan.
- GHG emissions are strongly influenced by energy prices and economic activity. The decrease in GHG emissions in the early 1980s can largely be attributed to increasing energy costs and the economic recession.
- Other factors, such as weather, can also influence GHG emissions.

In December 1997, 160 nations negotiated the Kyoto Protocol under which industrialized countries will collectively reduce greenhouse gas emissions by 5.2%.

Why is it important?

- Human activities, such as the burning of fossil fuels, are adding significant quantities of carbon dioxide and other greenhouse gases to the earth's atmosphere. The scientific community has concluded that elevated levels of greenhouse gases are causing changes to the global climate.
- The impacts of climate change may be far-ranging and include rising temperatures, changing precipitation patterns, the disruption of major weather and ocean systems and the loss of biodiversity due to the rate and magnitude of environmental change surpassing the natural ability of some species to adapt.

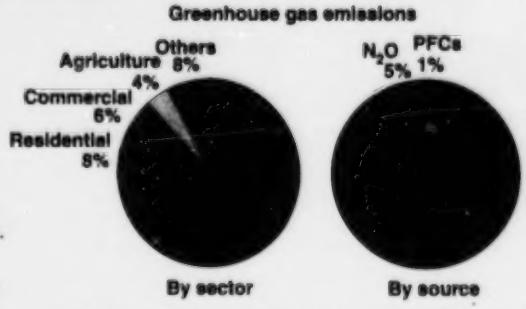
What is being done?

- The Greenhouse Gas Forum has been established to advise the government on ways to reduce greenhouse gas emissions.
- Specific actions include the development of Transportation Demand Management Plans, and the promotion of cleaner technologies through the Green Economy and Clean Energy Initiatives. The Public Buildings Energy Retrofit Program will provide a showcase for the promotion of cleaner technologies.
- British Columbia is leading the Greenhouse Gas Emission Reduction Trading Pilot (GERT), a program designed to test the effectiveness of emission trading for greenhouse gases in the Canadian context.

CANADA'S GOAL: *In 1997 Canada participated in the development of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which, when ratified, will commit Canada to reduce greenhouse gas emissions to 6% below1990 levels, by between 2008 and 2012.*

What are the sources of greenhouse gas emissions?

- Transportation is the single largest source of GHG emissions in the province.
- GHG emissions from gasoline and diesel cars and trucks increased by almost 20% from 1990 to 1997.
- Eighty-eight percent of industrial emissions were from the burning of fossil fuels. The remaining 12% were due to industrial processes.
- Carbon dioxide is the most abundant GHG. Carbon dioxide accounted for 49.6 megatonnes or 79% of British Columbia's GHG emissions in 1997 and methane accounted for 9.1 megatonnes or 15%.

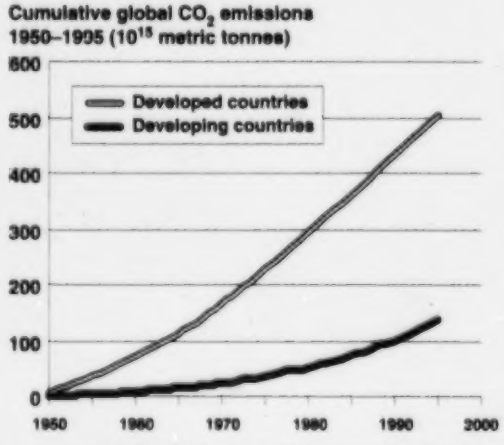


sources: Environment Canada, 1999, *Canada's Greenhouse Gas Inventory*.
notes: Values for sources in kilotonnes are: carbon dioxide (CO_2) 49,000; methane (CH_4) 9,000; nitrous oxide (N_2O) 3,200; and perfluorocarbons (PFCs) 700. For sectors in kilotonnes: transportation 25,100; industry 20,613; residential 4,790; commercial (includes institutional and other) 3,560; agriculture 2,600; and others (includes waste emissions) 4,810.

In 1998 British Columbians drove an average of 10,200 kilometres per capita, up from 7,000 kilometres per capita in 1970.

Can Canadians have an impact on greenhouse gas emissions?

- Developed countries have emitted 500 petatonnes or 63% of greenhouse gases over the past 50 years.
- Developing countries have emitted 37% of greenhouse gases over the past 50 years.
- In 1995 six jurisdictions (United States, European Union, former USSR, Japan, India and China) contributed 72% of the world's total GHG emissions. The other 139 countries that monitored GHG emissions each contributed less than 2% of the global total.
- In 1995 Canada contributed 1.9% of the world's GHG emissions.
- The cumulative effort of both the large and smaller emitters will be required to decrease overall emissions.

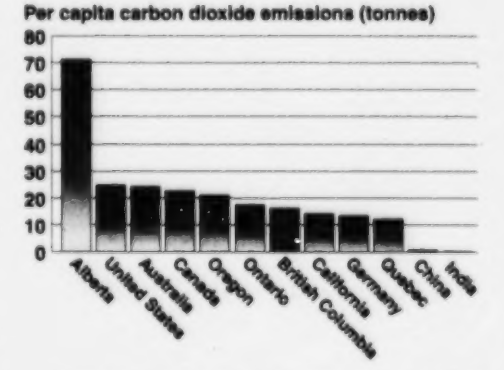


sources: G. Marland et al., 1999, *Global, Regional, and National CO_2 Emissions*. Oak Ridge National Laboratory, US Department of Energy, Oak Ridge, Tenn.

In order to reduce total GHG emissions in British Columbia, significant reductions in emissions from transportation will be required, including reductions in the distance travelled per vehicle, the number of vehicles travelling and emissions per vehicle.

How does British Columbia compare?

- British Columbia's per capita carbon dioxide emissions are in the same range or lower than other North American jurisdictions, but higher than most European countries.
- Energy-intensive settlement and transportation patterns, industrial activity and high levels of consumption all contribute to British Columbia's relatively high per capita carbon dioxide emissions.
- Currently, per capita greenhouse gas emissions are greatest in industrialized countries. Although per capita emissions are increasing in developing countries, the gap between the total contribution of developed and developing countries is still wide.

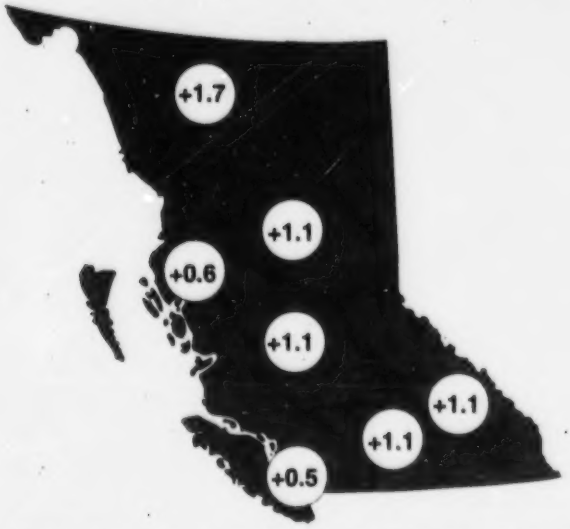


sources: Greenhouse gas emission estimates are from: Environment Canada, Pollution Data Branch, 1998; Statistics Canada, 1998; UNFCCC, 1999; California Energy Commission, 1998; and Oregon Department of Energy, 1998. Population estimates are from: Statistics Canada, 1998; International Data Bank, 1996; and State Population Estimates, 1998.
notes: These data are for 1996.

Per capita carbon dioxide emissions are significantly higher in North America and Australia than in industrialized countries in Europe and Asia.

Effects of Global Climate Change in British Columbia

Temperature change (°C) over the past century in British Columbia



source: Canadian Institute for Climate Studies, 1999. notes: All values are statistically significant at the 95% level. Data for the Boreal Plains and Taiga Plains in the northeast corner of British Columbia are insufficient to provide trend information. For values to be statistically significant, a clear trend must emerge from the yearly variation that occurs over a century.

Over the past century the interior of British Columbia has warmed at about twice the rate of the global average.

Status and trends in climate change

- Observations from around the world show a global warming trend of 0.3 to 0.6°C over the past century.
- Globally, 1998 was the warmest year since reliable record-keeping began in the late 19th century. The second warmest year was 1997, and seven of the 10 warmest years occurred in the 1990s.
- Warming has not been globally uniform. Some areas, such as parts of the southeastern US and northern Europe have cooled.
- Coastal British Columbia has warmed at about the same rate as the global average — about 0.6°C over the past century. The interior of British Columbia has warmed at twice the rate of the global average — over 1°C over the past century.
- Climate change is a complicated phenomenon, involving more than temperature changes. For example, associated with temperature increases has been an observed increase in sea levels, at an average rate of one to two mm per year over the past 100 years.

Globally, 1998 was the warmest year on record.

Why is it important?

- The impacts of climate change may be far ranging and include rising temperatures and sea levels, changing precipitation patterns and the disruption of major weather and ocean systems.
- The potential effects of climate change in British Columbia include: more extreme weather events; increased rainfall and reduced mountain snowfall on the coast; altered stream flows resulting in more frequent spring flooding; declining fish stocks; and increased frequency of forest fires and pest infestations.

What is being done?

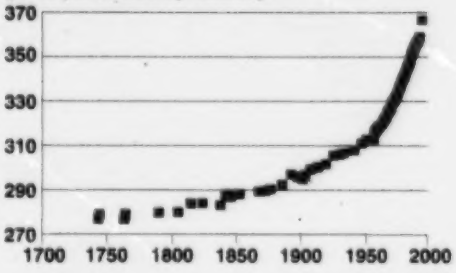
- In response to the 1997 Kyoto Protocol, Canadian ministers of energy and environment have established the National Climate Change Process. This process, in which BC has been fully engaged, is developing options on how Canada can meet its reduction targets. It has involved over 450 experts from various sectors across Canada.
- Canada's joint ministers of energy and environment are expected to reach decisions in Fall 2000 on Canada's National Implementation Strategy and on Canada's position at the next international negotiating forum in November 2000.

BRITISH COLUMBIA'S GOAL: *Reduction of greenhouse gas emissions. This will be achieved through a variety of approaches, including the Green Economy Initiative.*

Is global atmospheric carbon dioxide increasing?

- Since pre-industrial times the atmospheric concentration of carbon dioxide has increased by 30%, methane by 145% and nitrous oxide by 15%. Carbon dioxide is responsible for about 65% of the human-induced greenhouse effect.
- The balance of evidence suggests that the increase in greenhouse gas concentrations is responsible for global warming.

Global carbon dioxide concentrations (parts per million by volume)

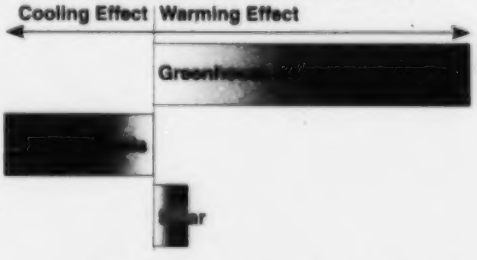


source: A. Nahtal at al., 1985, *Nature* 315:45–47; H. Friedli et al.,1986, *Nature* 324:237–238; C.D. Keeling, Scripps Institute of Oceanography, Mauna Loa, Hawaii; US National Oceanic and Atmospheric Administration (NOAA), Climate Monitoring and Diagnosis Laboratory, Carbon Cycle – Greenhouse Gases.

What factors contribute to global climate change?

- Human activities over the last 150 years have significantly altered the composition of the atmosphere and thus enhanced its ability to retain heat.
- Greenhouse gases act radiatively to warm the atmosphere. Their effect is long-lived.
- In opposition, the presence of aerosols combined with the depletion of the stratospheric ozone layer, have a cooling effect.
- Most aerosols remain in the atmosphere for a short time (days) and generally affect only local climates.
- Greenhouse gases remain in the atmosphere for many years and are globally distributed.

Relative importance of factors contributing to global climate change



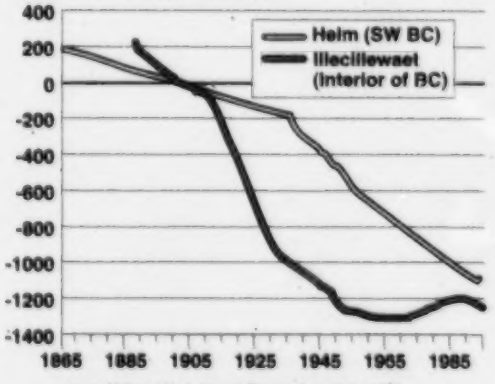
source: Adapted from World Meteorological Organization and the United Nations Environment Program, 1995. notes: Greenhouse gases include carbon dioxide, methane, nitrous oxide, ozone and halocarbons. Aerosols include dust particles and very small chemical droplets.

The cooling effect of short-lived, locally distributed aerosols does not provide a global offset for the warming effect of long-lived, globally distributed greenhouse gases.

Are British Columbia's glacier's melting?

- Glaciers in tropical and temperate zones worldwide have been retreating over the past century. This is one of the clearest indicators of climate change.
- Since 1900 the Helm Glacier in southwestern British Columbia and the Illecillewaet Glacier in the interior of the province have both retreated by over 1,100 metres. Wedgemount Glacier, near Whistler, has retreated hundreds of metres in the past two decades alone.
- Changes in glacier run-off have profound effects on the volume and timing of water discharged into rivers, with important consequences for water supplies, hydro-electricity generation, maintaining river and riparian habitats, fish populations and recreational use.

Change in the position of the glacier front relative to 1900 (in metres)

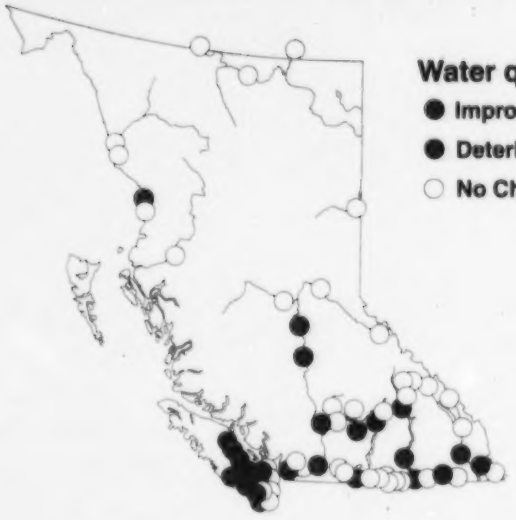


source: National Hydrological Research Institute, 1999.
notes: Helm Glacier is in Garibaldi Provincial Park, southwestern BC, and Illecillewaet Glacier is the north-extending tongue of the Illecillewaet Icefield in Glacier National Park, in the interior of British Columbia.

Glaciers and icefields are essential to British Columbia as stores of fresh water, regulators of high-altitude ecosystems and places of special beauty.

Surface Water Quality in British Columbia

Since 1985, water quality in British Columbia has remained stable at 60%, improved at 29% and deteriorated at 11% of the sampling stations.



source: BC Ministry of Environment, Lands and Parks, and Environment Canada, 2000. *Water Quality Trends in Selected British Columbia Waterbodies.*

Water quality monitoring stations are established on a priority basis and are chosen where human activities have a high potential of negatively impacting water quality.

Status and trends in water quality

- Results of trend assessments at 63 water quality sampling stations, a majority of which have at least 10 years of data, are shown on the accompanying map.
- For each of the seven stations with deteriorating water quality, characteristics of concern and implications vary.
- Discharges from mining operations have the potential to affect aquatic life in the Quinsam River at the mine and in the Elk River. Government and the companies involved are developing plans to address concerns in these water bodies.
- Declining fisheries production in Kootenay and Arrow lakes is a result of upstream dams and reservoirs. Efforts to mitigate this problem, by fertilization, have been successful in Kootenay Lake and have begun in the Upper Arrow Lake.
- Non-point source pollution has impacted water quality for recreation, drinking water, and aquatic life in the Salmon River at Salmon Arm and the South Thompson River at Kamloops. A multi-faceted approach, involving actions such as watershed restoration and pollution prevention, is being taken by industries, communities, and several levels of government to address these problems.
- In Quamichan Lake near Duncan, naturally high waterfowl populations make the water unsuitable for swimming.

A new Fresh Water Strategy provides a cohesive framework for the protection of British Columbia's water.

Why is it important?

- Protecting drinking water quality and maintaining the integrity of aquatic ecosystems are important environmental issues for British Columbians.
- British Columbia has 25% of the flowing fresh water in Canada. Ongoing monitoring, protection and careful management of these water resources are of critical importance.

What is being done?

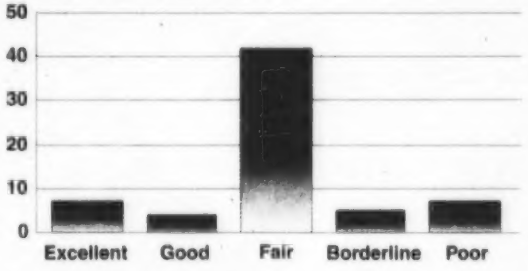
- A Non-point Source (NPS) Pollution Action Plan is addressing several problems in declining water quality.
- The impacts of industrial effluent and agricultural run-off will continue to be reduced through initiatives such as pollution prevention projects and the agricultural code of practice.
- Upgrades to sewage treatment facilities and the implementation of liquid waste management plans continue to help reduce the impacts of residential sewage. Successful examples include upgrades at the Annacis and Lulu Island plants, which discharge into the Lower Fraser River. Both plants have been upgraded from primary to secondary treatment.
- Water quality for fish is being addressed through the Watershed Restoration Program, Watershed Plans, the *Fish Protection Act* and the *Forest Practices Code.*
- A new inventory program has been established to protect 64 priority community watersheds from the impacts of forestry.

BRITISH COLUMBIA'S GOALS: *Clean, healthy and safe land, water and air for all living things, and provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment.*

Status of water quality

- Regular monitoring for the attainment of water quality objectives is conducted on a small percentage of water bodies where water quality problems are most likely to occur.
- The number of water bodies monitored fluctuates based on available resources. This number has decreased from 124 in 1995 to 16 in 1997.
- Twelve of the 64 water bodies that have been monitored between 1993 and 1997 received Borderline or Poor ratings, due primarily to pollution from non-point sources.
- Two-thirds of the monitored water bodies were rated as Fair, indicating some impairment of uses and the need for actions to prevent further impairment.
- Of the six water bodies that received a lower ranking in 1997 than in 1995, four are in the Southern Interior ecoprovince, and two are in the Georgia Depression.
- Red Top Gulch Creek, in the Southern Interior, has declined from Good to Fair over the last five years, due to increases in sulphate, dissolved solids and nitrate from nearby mining activities.
- Burrard Inlet–False Creek, in the Georgia Depression has improved from Borderline to Fair. The improvement can be attributed to the remediation of contaminated sites and changes to managing sewage discharge.

Number of water bodies monitored



Water Quality Index Definitions:
Excellent: Conditions very close to natural or pristine. All uses are protected and none are threatened or impaired.
Good: Conditions rarely depart from natural or desirable levels. All uses are protected, with only a minor degree of threat or impairment.
Fair: Conditions sometimes depart from natural or desirable levels. Most uses are protected, but a few are threatened or impaired.
Borderline: Conditions often depart from natural or desirable levels. Several uses are threatened or impaired.
Poor: Conditions usually depart from natural or desirable levels. Most uses are threatened, impaired or even lost.

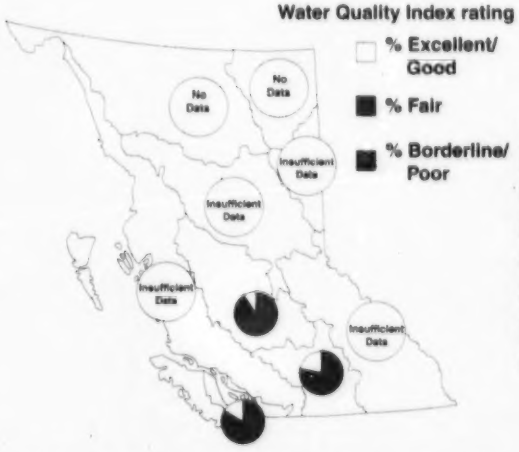
SOURCE: BC Ministry of Environment, Lands and Parks, 2000. Water Management Branch. NOTES: The ratings are derived from a Provincial Water Quality Index (WQI), which measures the impact of pollutants on water quality. Since the WQI is based on sampling in areas where there are likely to be water quality concerns, the results may indicate a poorer state than if a random sampling of all water bodies in the province was considered. Individual indices are determined by the number of water quality objectives not met and the frequency and amount by which these objectives are exceeded. Data for the WQI were taken from 64 water bodies (including fresh surface streams, rivers and lakes, and marine areas) for which at least three years of data were collected between 1992 and 1997. Most of the thousands of water bodies in the province are not monitored.

None of the 33 monitored water bodies used for drinking water in British Columbia received Poor or Borderline rankings.

In some water bodies marked improvements have been recorded. For example, decreases in spring total phosphorous in Osoyoos Lake has shifted the rank of this lake from fair in 1993 to excellent in 1997.

What is the water quality across the province?

- Water quality is not being monitored in two of the nine ecoprovinces and is minimally monitored in four others.
- In the heavily populated Georgia Depression and Southern Interior ecoprovinces, 47 water bodies were monitored. Water quality is Excellent or Good in 19%; Fair in 62%; and Poor or Borderline in 19%.
- The high percentage of water bodies rated as Fair indicates a need for vigilant monitoring as well as actions to prevent further degradation and costly restoration.
- Water quality ratings are generally highest in the less populated ecoprovinces, such as the Coast and Mountains, Southern Interior Mountains, and Sub-Boreal Interior.

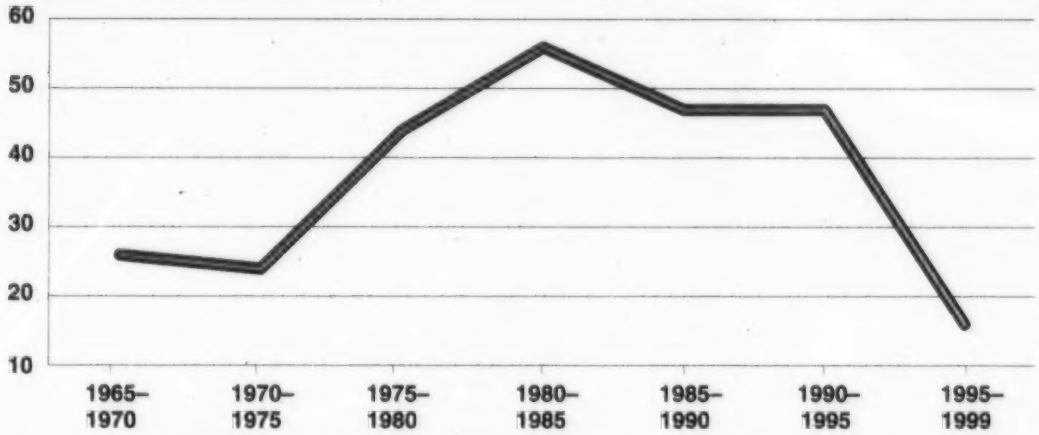


SOURCE: BC Ministry of Environment, Lands and Parks, 2000. Water Management Branch. NOTES: The number of water bodies in each ecoprovince is: Georgia Depression 24; Southern Interior 23; Central Interior 11; Southern Interior Mountains 1; Coast and Mountains 1; Sub-Boreal Interior 2; Boreal Plains 2; Northern Boreal Mountains 0; and Taiga Plains 0.

Twenty percent of the monitored water sources in the Georgia Basin and 17% in the Southern Interior are rated as Poor or Borderline.

Groundwater in British Columbia

Percentage of observation wells with declining water levels



source: BC Ministry of Environment, Lands and Parks, 1999. Water Management Branch. NOTES: Number of sampled wells with suitable long-term trend data increased from 31 to 150 over the 30-year period. Due to missing data, loss of observers, etc., only 139 sites were suitable for trends analysis for the period 1995–1999.

Of the 133 wells that were monitored between 1995 and 1999, 22 wells were declining, 45 were increasing and 72 had no change in water levels.

Status and trends in groundwater supply

- Long-term trends in groundwater levels are monitored at 150 observation wells throughout British Columbia. Due to missing data, only 139 wells were used for the 1995–1999 trend analysis.
- The percentage of wells showing declining water levels increased from 26% in 1965 to a high of 56% in 1980. Since 1980, normal or above normal precipitation has resulted in the replenishment of water levels in some wells and a decrease in the percentage of wells showing declining water levels. This indicates that climatic factors are the principle agents affecting groundwater levels in the province.
- Wells still showing declining water levels between 1985 and 1999 are located in areas of the province where groundwater demand is increasing during dry summer conditions. These areas are the east coast of Vancouver Island, Lower Mainland and Southern Interior.
- Groundwater users do not need a water licence in British Columbia. As a result, there are no reporting requirements for data on the actual volume of groundwater being withdrawn.

Groundwater sources supply approximately 25% of the total municipal water demand in British Columbia, excluding Greater Victoria and Vancouver.

Why is it important?

- Approximately 750,000 people in British Columbia depend on groundwater sources.
- In some areas where available surface water supplies are already fully allocated or are too costly to develop, groundwater is the only viable and cost-effective source of water supply.
- Excluding Greater Victoria and Vancouver, groundwater sources supply approximately 25% of the total municipal water demand in British Columbia. This is expected to increase in the near future, particularly in rural areas.
- Groundwater contributes to the year-round base flow for fish-bearing streams and wetlands.
- Groundwater is difficult to observe and there is limited understanding of its location, quantity and quality throughout British Columbia.

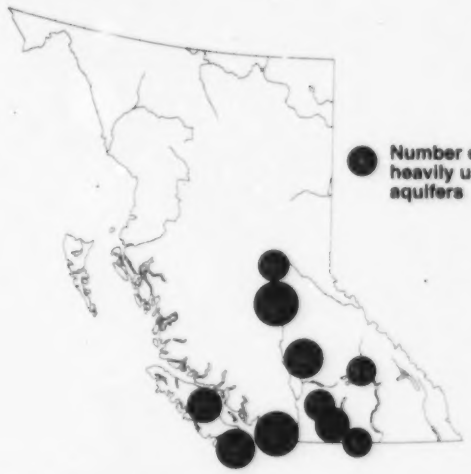
What is being done?

- The government is currently examining non-regulatory approaches to groundwater protection.
- The development of well and aquifer protection plans at the community level are being encouraged in co-operation with government agencies and water purveyors.
- Enhancements are being made to groundwater inventory activities.

BRITISH COLUMBIA'S GOAL: *Clean, healthy and safe land, water and air for all living things. The province's aim is to reduce the percentage of wells with declining water levels resulting from human activities.*

Where is groundwater demand highest in British Columbia?

- A map-based system for classifying groundwater reservoirs (aquifers) to assess risks to their supply and quality has been developed.
- Since 1996, 104 new aquifers have been identified and classified, raising the current inventory to 296.
- The total number of heavily used aquifers is now 26 (up from 17 in 1996). The majority of these aquifers are in the Fraser Valley, the east coast of Vancouver Island and the Southern Interior.
- While supplies of groundwater are clearly under stress in these aquifers, heavy use can also put the quality of water at risk. For example, excessive groundwater withdrawals in coastal regions are causing salt-water intrusion and groundwater quality degradation in some areas of the Gulf Islands and the Saanich Peninsula.

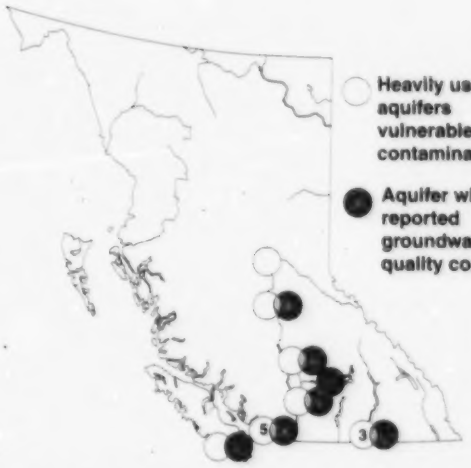


source: BC Ministry of Environment, Lands and Parks, 1999. Water Management Branch.

Groundwater supply in 91% of the classified aquifers is not at risk. However, in 9% of the classified aquifers, groundwater supply may be at risk due to heavy use.

Is British Columbia's groundwater contaminated?

- Thirty-one percent of the classified aquifers in British Columbia (down from 36% in 1996) are considered to be highly vulnerable to contamination. Changes since 1996 are a result of an increase in the number of aquifers identified. Natural characteristics are used to determine vulnerability.
- Thirteen aquifers (up from 11 in 1996) have been identified as having the greatest risk of declining quality. Many of these provide drinking water to large communities; for example, the Township of Langley and the City of Abbotsford.
- Specific sites within 28 aquifers (up from 17 in 1996) have been reported with health-related water quality concerns (based on *Guidelines for Canadian Drinking Water Quality*). Eleven of these aquifers (up from 10 in 1996) are in the Fraser Valley.
- Through notifications to owners, bulletins and workshops, municipal, provincial and federal governments have worked together to inform people in affected areas and to develop community-based solutions.
- Nitrate levels exceed guidelines in 16 of the 28 aquifers, probably due to leaching from agricultural fertilizer, manure application and/or septic fields.



source: BC Ministry of Environment, Lands and Parks, 1999. Water Management Branch. notes: 1. Each circle represents one aquifer of concern within the given area unless otherwise indicated by numbers. 2. The *BC Water Quality Status Report*, 1996, describes in more detail the state of water quality in some aquifers. 3. Most information is collected in areas of highest population density. Little is known about groundwater in British Columbia outside these areas.

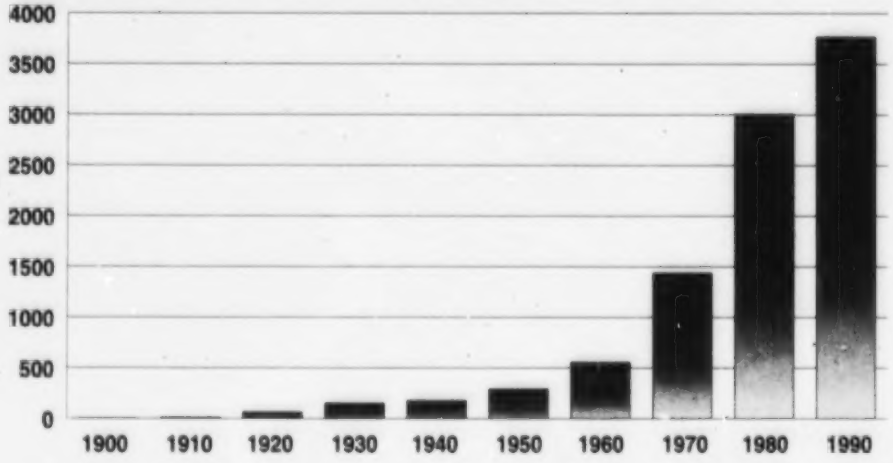
One in three classified aquifers in British Columbia is potentially vulnerable to contamination.

A nutrient management strategy is currently being prepared by the joint Environment/Agriculture Committee.

- Some contaminants (e.g., nitrate) are primarily the result of human activities and are of greatest concern in those aquifers considered vulnerable to contamination. Others are naturally occurring (e.g., fluoride, arsenic) and affect water quality even in groundwater sources that are not at risk of contamination from human activities.

Water Use in British Columbia

Cumulative stream restrictions by decade



sources: BC Ministry of Environment, Lands and Parks, November 1999. notes: Bars represent cumulative totals by decade. The word "streams" in this context covers all fresh water in British Columbia, including rivers and lakes. Restrictions apply to all water upstream of the restriction.

Since 1970 the number of restrictions registered against streams in British Columbia has increased more than 2[*] times.

Status and trends in water use

Status and trends in stream restrictions are indicative of the intensity of water use, pressures on water supply and intensity of water management.

- When the demand for water licences exceeds the capacity of a water supply, the provincial government places restrictions on the further use of that water body.
- The number of restrictions registered against streams in British Columbia was seven times higher in the 1990s than the 1960s.
- The dramatic increase in restrictions in recent decades indicates the increase in the number of streams that are reaching capacity for water use.
- Over half of the restrictions are in five of the 43 water districts in the province: Nelson, Kamloops, Victoria, Cariboo and Vernon.
- Stream restrictions are used as a management tool to ensure that water supply in the province is maintained. Restrictions may range from including minimum fish flow clauses in a water licence, to suspending the issuance of any further licences on a water body.
- The number of restrictions on British Columbia streams is indicative of the intensity of water use in the province, pressures on water supply and the intensity of water management that is required to maintain that water supply.

Why is it important?

- Water has numerous and often competing users. These include: agriculture, recreation, industry processes and waste disposal; domestic uses, including drinking water; and habitat for aquatic organisms. To ensure availability for all users, water is carefully managed.
- Demand for water influences stream flows and water levels. Demand tends to be highest in summer, when water supplies are usually lowest.
- Water shortages affect not only everyone that uses the water, but also the plant and animal life that depends on that water body for survival.

What is being done?

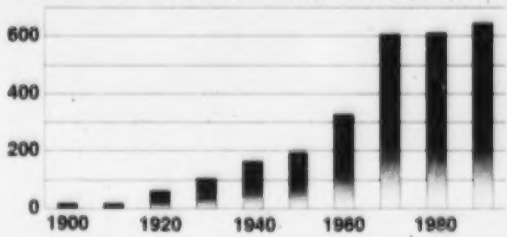
- The *BC Water Protection Act* (1995) prohibits large-scale diversions between watersheds and new licences for the export of bulk water.
- The Fresh Water Strategy for BC (1999) consolidates provincial initiatives into one cohesive strategy. Initiatives include: designating sensitive streams under the *Fish Protection Act*, which restricts the approval of new water licences; implementing a three-year Drinking Water Strategy; and investigating economic and social approaches to promote water conservation — for example, education and appropriate pricing.

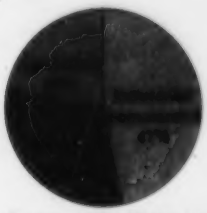
BRITISH COLUMBIA'S GOALS: *Clean, healthy and safe land, water and air for all living things, and provision of social, economic and outdoor recreation opportunities consistent with maintaining a naturally diverse and healthy environment.*

Who are the users of British Columbia's water?

- The total amount of surface water licensed in the province doubled between 1960 (326 billion m^3) and 1990 (646 billion m^3).
- Power production, including storage for power production, is the largest use of surface freshwater in the province. Just under 632 billion m^3 are now licensed for these purposes, or over 97% of the total volume of water licensed in British Columbia.
- The remaining 3% of water licensed is for consumptive uses such as industrial/commercial, drinking water or agriculture.
- Water licences specify the maximum volumes that may be used for a given purpose — the actual amount of water used may be less.

Volume of surface water licensed (billion m^3/year)





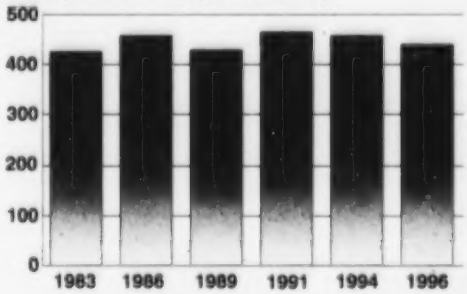
Consumptive Water Use

sources: BC Ministry of Environment, Lands and Parks, 1999.
notes: Values for consumptive water use are (in billion m^3 per year): drinking water 1.87; agriculture 1.34; and industry/commercial 2.8.

How much water do British Columbia residents use?

- Per capita domestic water consumption in British Columbia has not changed much since the early 1980s. In 1996 the average British Columbian used 440 litres/day, an increase of 16 litres from 1983 (424 litres/day).
- Approximately 65% of indoor home water use occurs in the bathroom — only 10% is used in the kitchen and for drinking. Toilets are the single greatest water use in the home.
- Demand for water nearly doubles in the summer, primarily for watering lawns and gardens.
- Per capita domestic use is higher in the province's smaller communities. In 1996 the average person in a small community (less than 50,000) used 531 litres/day. For the same year an individual in a larger community (greater than 50,000) used 398 litres/day.

Per capita water use (L/person/day)



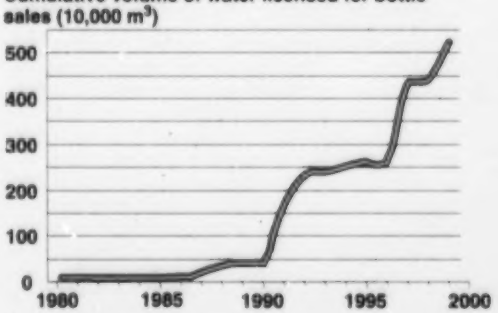
sources: Environment Canada, Municipal Water Use Database (MUD), 2000. notes: It is important to note that after being used, domestic water is subject to costly water treatment to make the receiving aquatic environment livable for aquatic organisms and safe for human consumption and recreation.

In 1996, British Columbians used 35% more water per capita than the average Canadian, and over twice as much as the average British citizen.

What is the trend in the volume of water licensed for bottled water use?

- Bottling water for sale is a relatively new use of licensed water in British Columbia. The first licences for this use were issued in 1972 (13,267 m^3/yr).
- The volume of water licensed for bottled water sales has increased dramatically in the 1990s. As of November 1999, just over 5 million m^3/yr were licensed for this use. This is still a tiny fraction of the total volume currently licensed for all uses.
- Water packaged in containers smaller than 20 litres is not considered bulk water and is legally allowed to leave the province.

Cumulative volume of water licensed for bottle sales (10,000 m^3)

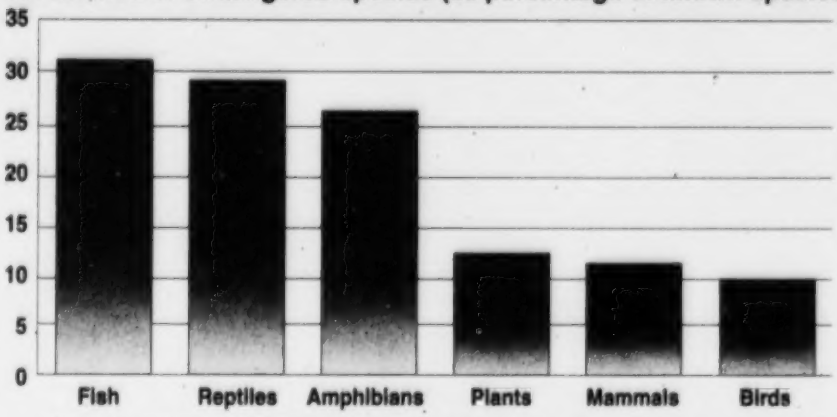


sources: BC Ministry of Environment, Lands and Parks, 1999.
notes: Licences are for surface water only; the use of groundwater is not licensed. "Surface water" includes springs that naturally reach the surface, even if only for part of the year.

Species at Risk in British Columbia

Approximately 12% of vascular plants and 15% of vertebrate animals are threatened or endangered in British Columbia.

Threatened or endangered species (as percentage of known species)



source: BC Ministry of Environment, Lands and Parks, 1999. Conservation Data Centre. notes: Plants are restricted to vascular plants. The total threatened or endangered species /native breeding species in each group is: freshwater fish 26/84; reptiles 4/14; amphibians 5/19; vascular plants 241/2042; mammals 11/104; breeding birds 29/290. Species at risk are designated as: *endangered* when they are facing imminent extinction or extirpation; *threatened* when they are likely to become endangered if factors affecting their vulnerability are not reversed; or *vulnerable* when they are of special concern because of characteristics that make them particularly sensitive to human activities or natural events.

Threatened or endangered species include the Salish Sucker, Oregon Spotted Frog, Golden Paintbrush, White-headed Woodpecker and Spotted Owl.

Status and trends in species at risk

- In British Columbia 75 species of vertebrate animals and 241 vascular plant species are listed as either threatened, endangered or candidates for these designations.
- An additional 420 vertebrate animal and vascular plant species are classified as vulnerable. Vulnerable species are also considered at risk and include the White Glacier Lily, Painted Turtle and Grizzly Bear.
- Since 1996, six birds, including the Marbled Murrelet and Broadwing Hawk, one reptile (the Western Pond Turtle), one amphibian (the Oregon Spotted Frog) and one mammal (the Badger) have been added to the threatened or endangered species list. In that time one bird (Sprague's Pipit) and two mammals (the Northern Long-eared Myotis and Dall's Sheep) have been removed from the threatened or endangered species list.
- Most of the increases to species at risk lists are a reflection of better tracking.
- Species lists have been expanded to include invertebrate animals such as insects (120 listed as threatened, endangered or vulnerable), moss species (306) and plant associations (241).
- Plant associations are unique ecosystems categorized by their species composition. They are home to many of the species at risk.

Four species have been legally designated as endangered under the Wildlife Act: Burrowing Owl, White Pelican, Sea Otter and Vancouver Island Marmot. This designation prohibits actions resulting in the death of an endangered species. The White Pelican and the Sea Otter have shown signs of recovery in recent years.

Why is it important?

- British Columbia is Canada's most biologically diverse province, and threatened or endangered species are an ecologically important part of this biodiversity.
- Diverse and viable populations of wild plants and animals are vital to long-term economic and social well-being.

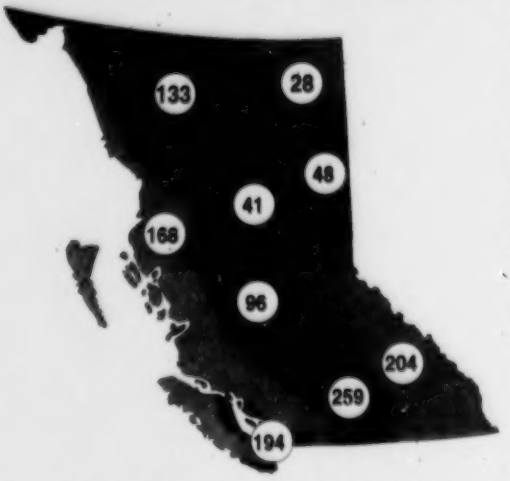
What is being done?

- British Columbia is committed to the National Accord for the Protection of Species at Risk. All provinces have agreed to protect species and their habitats and develop recovery plans for nationally designated threatened or endangered species. The National Accord emphasizes preventative measures, stewardship initiatives and the need for partnerships on both public and private lands.
- British Columbia will respect prohibitions and implement recovery plans as outlined in the proposed federal *Species at Risk Act.*
- The Protected Areas System is the cornerstone of the province's initiatives to protect species at risk. It sets aside important habitats, with conservation and recreation as management priorities.

BRITISH COLUMBIA'S GOALS: *Protection, conservation and restoration of a full range of biological and physical diversity native to British Columbia. Starting in the year 2000, British Columbia will approve five new recovery plans for endangered species each year.*

Where are the species at risk found?

- The Southern Interior ecoprovince has the largest number of species at risk (259), followed by the Southern Interior Mountains (204) and the Georgia Depression (194).
- In these ecoprovinces, regions of high biodiversity coincide with human expansion resulting in habitat loss.
- Species at risk in the Southern Interior include the Burrowing Owl. The grassland habitat this bird relies on is restricted to valley bottoms and is being replaced by agriculture and urban development.
- Species at risk in the Georgia Depression include the Vancouver Island Marmot — endangered due to habitat alteration, predation and disease. There are an estimated 50 marmots left in the wild. A captive breeding project has been initiated to prevent these animals from becoming extinct.

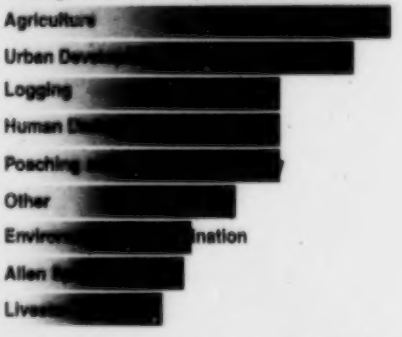


source: BC Ministry of Environment, Lands and Parks, 1999. Conservation Data Centre. NOTES: Circled numbers indicate the total number of threatened, endangered and vulnerable vertebrate animals and vascular plant species and sub-species. Since the release of *Environmental Trends in BC 1998*, a significant improvement in regional tracking has resulted in lower numbers of total species at risk for most ecoprovinces.

What are the threats to species at risk?

- Agricultural and urban development and the conversion of old-growth forests to managed forest stands, alter natural habitat and pose a significant threat to vertebrate animals in British Columbia.
- In the Southern Interior and Georgia Depression, urban and agricultural development pose the greatest threats to vertebrates. In the Southern Interior Mountains, logging, followed by urban development, poses the greatest threat.
- Wetland species, such as the Oregon Spotted Frog, Western Pond Turtle and Sandhill Crane, are particularly threatened by development.
- Although alien species do not pose the most significant overall threat, they pose a significant threat to amphibians and plants.

Relative importance of threats to threatened and endangered (Red-listed) vertebrates

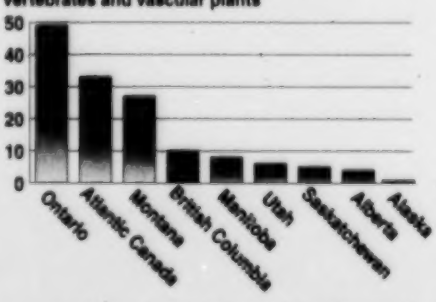


source: BC Ministry of Environment, Lands and Parks, 1999. Wildlife Branch. NOTES: Does not include fish or marine mammals. Human disturbance includes both the deliberate and accidental disturbance of animals; environmental contamination includes any chemicals added to the environment that affect species at risk; and other includes alteration of habitat due to fire supression and/or the effects of development not considered to be urban or agricultural (e.g., campsites).

How does British Columbia compare to other places?

- Extirpated species (i.e., those no longer in a particular location but found elsewhere) and extinct species provide an indication of the degree to which a jurisdiction's biological diversity has deteriorated.
- British Columbia has 10 extinct and extirpated species, compared to 49 in Ontario, 33 in Atlantic Canada, 27 in Montana, five in Saskatchewan, four in Alberta and one in Alaska.

Number of extinct and extirpated terrestrial vertebrates and vascular plants



sources: Conservation Data Centres or Heritage Programs for each jurisdiction, 1999. NOTES: Conservation Data Centres and Heritage Projects in British Columbia and elsewhere use a system of ranking species developed by The Nature Conservancy (US), which is internationally recognized and allows for comparisons between jurisdictions.

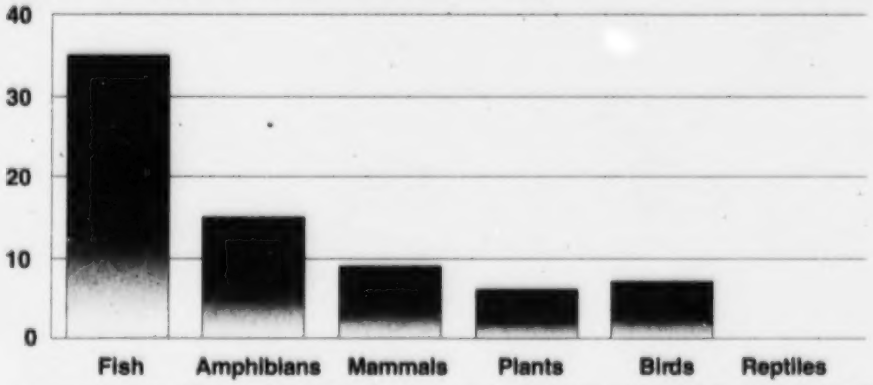
The South Okanagan Conservation Strategy is a new federal/provincial partnership being developed specifically to protect species at risk in the Southern Interior.

Two out of the four most endangered ecosystems in Canada are in British Columbia: the Garry Oak Woodlands of the south coast and the Antelope Brush Ecosystem of the Southern Interior.

Species extirpated from British Columbia are White-tailed Jackrabbit, Sage Grouse, Yellow-billed Cuckoo, Short-horned Lizard, Pink Sand-verbena and Common Downingia. Species now extinct are Passenger Pigeon, Dragon Lake Whitefish and Hadley Lake Limnetic and Benthic Sticklebacks.

Forest Species in British Columbia

Threatened or endangered forest species (as percentage of known forest species)



source: BC Ministry of Environment, Lands and Parks, 1999. Conservation Data Centre and State of the Environment Reporting Program.
notes: The total number of threatened or endangered forest-dwelling species/total number of forest-dwelling species in each group: freshwater fish 24/69; amphibians 2/13; mammals 6/64; vascular plants 49/792; birds 9/137; reptiles 0/4. Except for fish, a forest species was defined as a species that requires forest habitat for at least one of its life requirements. A forest was defined as an area having at least 10% tree cover. A forest-dependent fish was defined as a fish with high to medium dependence on forests.

Fifteen percent of forest-dwelling vertebrates and 6% of forest-dwelling vascular plants are threatened or endangered in British Columbia.

Status and trends in forest species

- In British Columbia, 8% of 1,079 known species of forest-dwelling vertebrate animals and vascular plants are threatened, endangered or candidates for these designations.
- The percentage of forest-dwelling vertebrates that are threatened or endangered increased by 2% between 1997 and 1999.
- Threatened or endangered forest species include Nooksack Dace, Pacific Giant Salamander, Keen's Long-eared Myotis, Silvery Lupine, Marbled Murrelet and Spotted Owl.
- Small organisms, such as non-vascular plants, invertebrates and fungi, comprise the majority of forest-dwelling species and fill an important role in the ecology of forests. However, very little is known about their status.
- Changes in the nature and extent of forest habitat affect the diversity of forest-dwelling vertebrate species. Species that require large ranges (e.g., Grizzly Bear, Wolverine) and those that are associated with older forests (e.g., Spotted Owl and Keen's Myotis) are most affected.

Key facets of the Forest Practices Code designed to protect biodiversity have not yet been fully implemented. These include Landscape Unit Planning, Identified Wildlife Management Strategy and Winter Ungulate Ranges.

Why is it important?

- Forests cover nearly two-thirds of British Columbia and provide a wide range of habitats for plants and animals.
- A significant portion of the species in British Columbia are forest-dependent. These include 82% of the the freshwater fish, 72% of the amphibians, 60% of the mammals, 50% of the breeding birds and 31% of the reptiles.
- Forest ecosystems and the species that live in them are closely linked to many other ecosystems. For example, through the exchange of species, gases, water and other material, aquatic ecosystems and forest ecosystems are highly interdependent. Even seabirds can be influenced by the nature and extent of forest practices in watersheds far from the ocean.

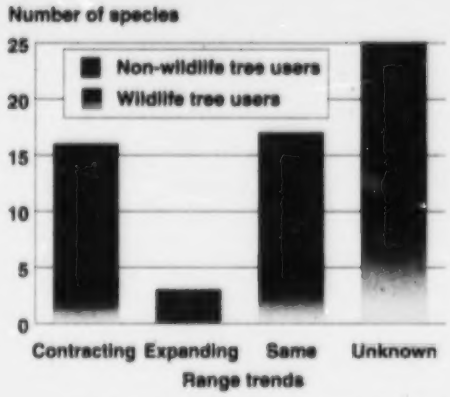
What is being done?

- The province is moving towards an ecosystem-based approach to managing biodiversity in forests, so that industrial forestry activities more closely resemble patterns of natural disturbance.
- The *Forest Practices Code of British Columbia Act* requires the maintenance of riparian reserves on larger streams, where fish are present, and recommends watershed assessments where logging practices may negatively impact fish.
- The *Identified Wildlife Management Strategy* provides guidelines to encourage habitat protection for some forest-dependent species.

BRITISH COLUMBIA'S GOALS: *Protection, conservation and restoration of a full range of biological and physical diversity native to British Columbia, and provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment.*

Is the range of forest mammals shrinking?

- Forty-four percent of the 36 forest-dwelling mammals with known range trends have contracting ranges. This trend may be an early-warning signal that species are moving towards endangerment.
- The three species that have expanded their ranges are associated with early-seral forests (Moose and White-tailed Deer) and/or are well adapted to rural development (White-tailed Deer and Coyote).
- The range trends of 40% of forest-dwelling mammal species are unknown, including 16 of 26 wildlife tree users.

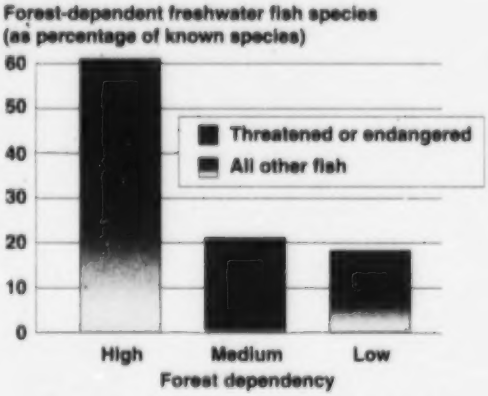


sources: Royal British Columbia Museum and BC Ministry of Environment, Lands and Parks, 1997. notes: A wildlife tree is defined as any standing dead or live tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife. Wildlife tree users are identified by the Wildlife Tree Committee of British Columbia. A wildlife tree user requires specialized habitat created by dead or decaying trees. Trends were evaluated using range expansions or contractions since 1900.

Four of the 16 forest-dwelling mammals with shrinking ranges use wildlife trees: Fisher, Caribou, Northern Flying Squirrel and Marten.

Are forest-dependent freshwater fish threatened?

- All of British Columbia's 83 native freshwater fish are considered dependent on forests to some extent because forests are the dominant factor determining water quality, quantity and temperature, and sediment delivery in rivers, streams and lakes.
- Fish with a high forest dependency require stream habitats to complete at least one stage of their life history. Streams are directly influenced by riparian forests that provide shade, organic litter and nutrients, and large woody debris for channel structure, stability and habitat diversity.
- Species with a medium forest dependency rely on lake habitats for one or more life stages. Lake habitats are assumed to be less influenced by adjacent forests than are streams. Lakes are indirectly influenced by forests through their effect on incoming streams.
- Fish with a low forest dependency can complete all life stages in habitats that have naturally low or unforested riparian areas (i.e., alpine), or in large rivers where riparian forests have minimal influence.
- Of the 51 fish species with a high forest dependency, eight are threatened or endangered (16%), including Broad Whitefish, Nooksack Dace and Umatilla Dace.
- Although some widely distributed forest-dependent salmonid species, such as Coho, Steelhead and Chinook, are not threatened or endangered across their entire range, specific genetic stocks are considered to be at risk of extinction.



sources: BC Ministry of Environment, Lands and Parks,1997, with assistance from BC Ministry of Forests, Royal British Columbia Museum, Canadian Department of Fisheries and Oceans, University of Victoria and University of Alberta. note: The number of threatened or endangered/total fish species is 8/51 for high forest dependency; 16/18 for medium dependency; 3/14 for low forest dependency.

Approximately one in three species of forest-dependent native freshwater fish is threatened or endangered in British Columbia. Many of these threatened or endangered fish are especially vulnerable to disturbances because they are naturally rare or have restricted distributions.

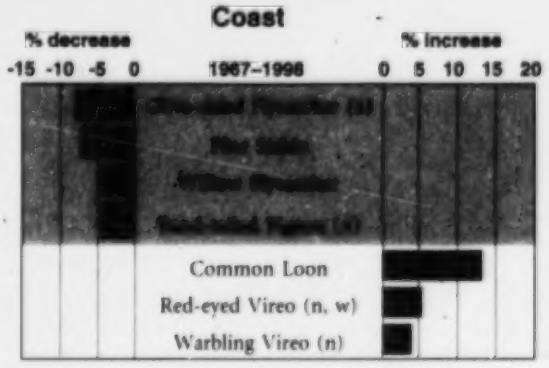
Are forest-dwelling birds declining in British Columbia?

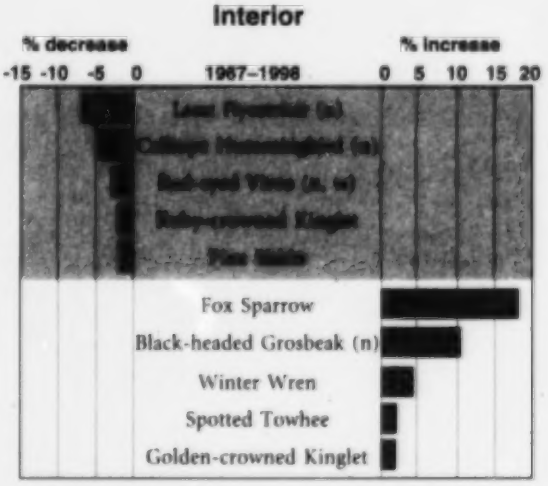
Most forest-dwelling birds included in the Breeding Bird Survey show no increasing or declining trend over the past 30 years.

- Fifty percent (135) of the native breeding birds in British Columbia live in forests, making their population trends important early-warning signals for the state of biodiversity in the province's forests.
- The Breeding Bird Survey is one source of reliable long-term information on trends in bird populations from 1967 to 1998. It includes 46% of the native breeding forest birds in British Columbia. However, rare, nocturnal, silent and interior forest birds are not included.
- Twenty-nine percent (18) of the forest bird species followed by the Breeding Bird Survey are neotropical migrants — birds that breed in British Columbia but spend most of their lives south of the United States. In British Columbia, most neotropical migrant birds included in the Breeding Bird Survey — nine on the coast and 12 in the interior — show no clear trends. Two species on the coast and three in the interior are declining; two species on the coast and one in the interior are increasing.

Significant population declines have been observed in some birds not included in the Breeding Bird Survey. Spotted Owls and Marbled Murrelets, both dependent on coastal old-growth forests for nesting habitat, have been declining over the past nine and 18 years respectively

- Fifty-four forest-dwelling birds are known as wildlife tree users because they require the specialized habitat created by dead or decaying trees. Of the 13 species included in the Breeding Bird Survey — eight on the coast and 10 in the interior — show no clear increasing or declining trend. In the interior one is declining, and on the coast one is increasing.
- It is important to note that significant population declines have been observed in some birds not included in the Breeding Bird Survey. At particular risk are birds dependent on coastal old-growth forests for nesting habitat. For example, Spotted Owl populations have declined by one-third in the past nine years. As well, Marbled Murrelets have been declining over the past 18 years in Clayoquot and Desolation Sounds and on the east coast of Vancouver Island.

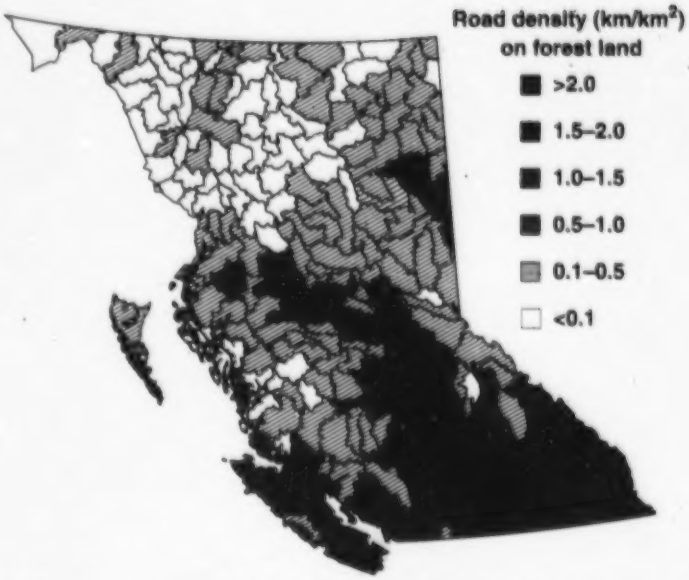




source: Canadian Wildlife Service, Breeding Bird Survey, 1999.
note: 46% (62) of the native breeding forest birds in British Columbia are included in the Breeding Bird Survey. Only forest birds showing clear trends (i.e., $p<0.15$) for the 30-year period between 1967 and 1998 are shown. n = neotropical migrant; w = wildlife tree user. The Coast includes the Coast and Mountains and Georgia Depression ecoprovinces; the Interior includes the Sub-Boreal Interior, Central Interior, Southern Interior and Southern Interior Mountains ecoprovinces. No Breeding Bird Survey data were available for the Northern Boreal Mountains, Taiga Plains and Boreal Plains ecoprovinces in northern and northeastern British Columbia.

Are roads intruding on forest habitat?

- As of 1988, there were 387,000 km of roads in British Columbia. Seventy-six percent of these are used to access forests for timber and recreation. The other 24% are comprised of main and secondary highways and other non-forest roads.
- Roads provide access to previously inaccessible forest areas for resource development and recreation. They can lead to increased development, habitat fragmentation and loss, roadkill, stream sedimentation and increased access by off-road motorized vehicles, such as snowmobiles and all-terrain vehicles.
- Road density on about 35% of the forest land in the province is greater than 0.5 km/km^2. At this density many wildlife populations are compromised.
- Avoidance of road networks has significant negative impacts on the behaviour of both vertebrate and invertebrate species. Other negative repercussions include population fragmentation, which in turn can diminish the genetic health of a population.
- Examples of road densities above which wildlife species are negatively impacted include: Grizzly Bear 0.4 km/km^2; Black Bear 1.25 km/km^2; and Elk 0.62 km/km^2.
- Bull Trout populations are extremely sensitive to road building and are affected by densities of 0.1 to 1.1 km/km^2.
- Some of the negative impacts of roads can be mitigated by regular road maintenance and access management, including road deactivation. An example of road access planning is the pilot project currently underway near Golden.
- Since 1988 (and not reflected in the road density map), the Ministry of Forests has built approximately 800 km of new roads per year. It is estimated that forest companies build three times this number per year in the forests of British Columbia. In the past 12 years, this amounts to over 38,000 kms of new roads on forest land.
- Since 1994, under the Watershed Restoration Program, administered by Forest Renewal BC, over 19,600 km of logging roads have been permanently or semi-permanently deactivated or repaired to help restore and protect water quality for people, fish and fish habitat.

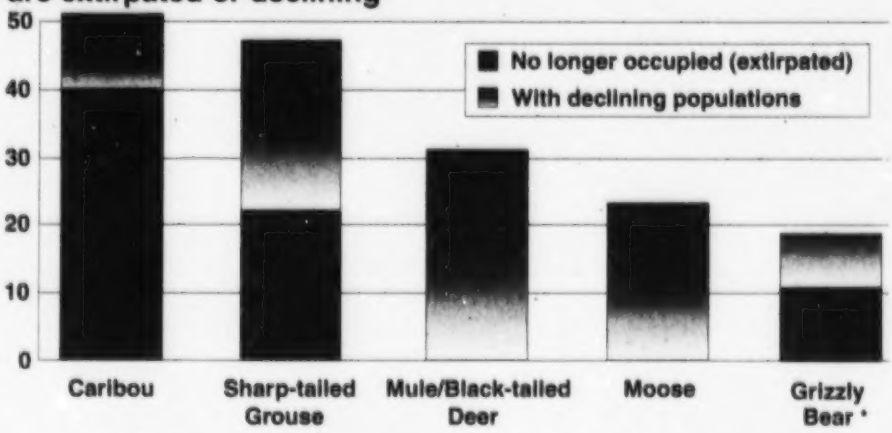


sources: BC Ministry of Environment, Lands and Parks, Geographic Data BC, 1999.
notes: Data are taken from 1981–1988 air photos (TRIM), the latest years for which road density data are available. Road densities are shown for each of the 246 watershed groupings in British Columbia. The km of each type of road are as follows: Total roads – 387,021; primary and secondary roads – 21,924; other non-forest roads – 59,858; forest service roads – 34,952; other forest roads 270,287.

Wildlife in British Columbia

Several wildlife species, including Caribou and Columbian Sharp-tailed Grouse, no longer occupy significant portions of their historical range since the 1950s.

Percentage of historical range in which species are extirpated or declining



source: BC Ministry of Environment, Lands and Parks, Wildlife Branch, 1999. note: * For Grizzly Bear the graph represents the percentage of historical range in which sub-populations are extirpated or threatened. Threatened sub-populations are those with poor to fair viability. The calculations for this graph were made from an assessment of historical (1960) and current habitat suitable for each species. The range of each species was calculated by ecosection, except for Caribou and Grizzly Bear, which were calculated using the distribution of sub-populations. Columbian Sharp-tailed Grouse is a subspecies of Sharp-tailed Grouse.

Status of wildlife populations

Some wildlife species, such as Mule/Black-tailed Deer and Moose, still occupy most of their historical range, although population declines in some areas are of concern.

- As a group, Caribou, Columbian Sharp-tailed Grouse, Grizzly Bear, Mule/Black-tailed Deer and Moose represent species of wildlife managed for conservation, recreation and sustenance uses. Together, they have historically ranged over most of the province and live in a variety of habitats.
- A number of managed wildlife species, such as Caribou, Columbian Sharp-tailed Grouse and Grizzly Bear, no longer occupy significant portions of their historical ranges.
- Other species occupy most of their historical ranges, although some have experienced population declines in large parts of those ranges.
- Mountain Caribou, which are the southern population of Caribou, are classified as threatened in British Columbia. Grizzly Bear and Columbian Sharp-tailed Grouse are classified as vulnerable.
- Mule/Black-tailed deer are declining in 31% of their historical range. Most of the decline is on Vancouver Island and in the Southern Interior. Cougar and wolf predation has been implicated in these declines.
- Moose are stable in most (77%)of their historical range. Declining populations are found in the interior of the province.

Why is it important?

- British Columbia's managed wildlife provide economic, social and natural diversity benefits.
- Many of British Columbia's managed wildlife populations are of national and international significance.
- Maintaining all species across their ranges is fundamental to preserving biodiversity.
- First Nations have a right to harvest wildlife for sustenance and cultural uses.

What is being done?

- The Protected Areas Strategy will help protect and conserve some wildlife habitat. This includes Columbian Sharp-tailed Grouse grassland habitat in the newly created Churn Creek and Lac du Bois protected areas.
- Conservation strategies have been developed for Grizzly Bear and Mountain Caribou and the Southern Interior ecosystem (home to some Columbian Sharp-tailed Grouse populations).
- Forty species and ecosystems are presently designated as Identifed Wildlife under the *Forest Practices Code*. These will be subject to special management considerations.
- Harvest levels and area closures for wildlife are assessed annually to ensure conservation priorities are met.

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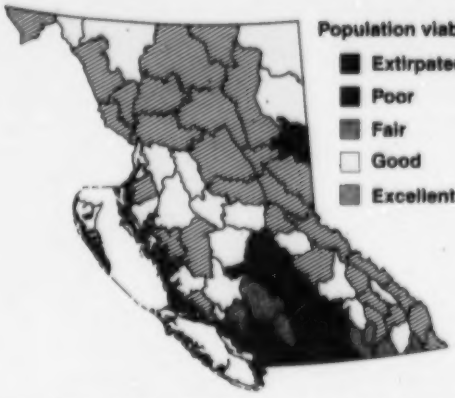
Has the range of Grizzly Bear changed?

- British Columbia is home to an estimated 10,000–13,000 grizzlies — half of Canada's and one-quarter of North America's current Grizzly Bear population.
- Historically, Grizzly Bears have ranged over most of the province. Today, their population is extirpated (locally extinct) in 11%, threatened (poor or fair) in 8%, and excellent or good in 81% of their historical range.
- Grizzly Bears are territorial and move over hundreds of kilometres. Their requirement for unfragmented habitat makes them particularly vulnerable to human settlement and resource development.

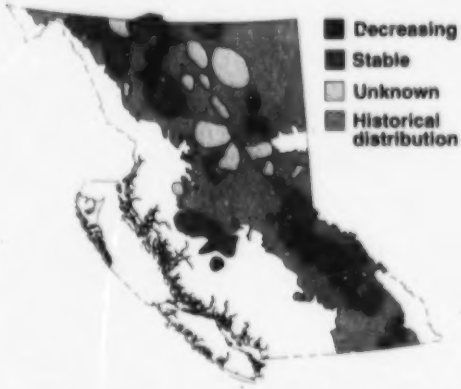


Grizzly Bears once ranged throughout much of North America, from Mexico to northern Canada and Alaska. Today, their range is less than half that area.

source: BC Ministry of Environment, Lands and Parks, Wildlife Branch, 2000.
NOTES: The delineations on this map represent Grizzly Bear sub-populations. Sub-population estimates are expressed as a percentage of the capability of the habitat to support Grizzly Bears. For example, excellent population viability means that the habitat is supporting more than 75% of the Grizzly Bears that it has the capability to support. The population viability for each category is: excellent >75%; good 50–75%; fair 25–50%; poor <25%.

Has the range of Caribou changed?

- British Columbia is home to an estimated 18,700 Caribou. The largest numbers are found in the northern mountains.
- The 42 sub-populations of Caribou vary in size from the Spatsizi herd, with 2,200 Caribou, to the George Mountain herd, with approximately 20 Caribou.
- Historically, Caribou were found from Northern BC to the Kootenays, in the southeast of the province.
- Today their populations are stable in 32%, declining in 11% and extirpated in as much as 40% of their historical range.
- The main threats to Caribou in British Columbia are logging of their old-growth forest winter range, predation, natural fires in the north and disturbance caused by humans on motorized vehicles such as snowmobiles and all-terrain vehicles.

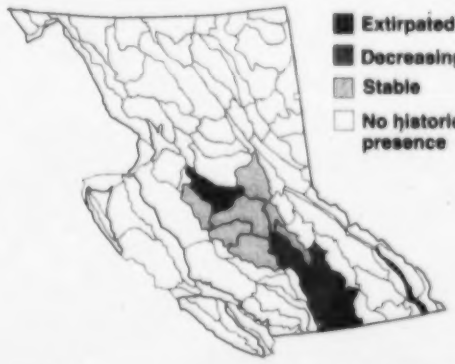


Since the 1950s changing land use practices, particularly in the south, have placed growing pressure on Caribou and their habitat.

source: BC Ministry of Environment, Lands and Parks, Wildlife Branch, 2000.
NOTES: The range for Caribou was calculated using the estimated historical and current range. The delineations on the map are sub-populations. Because of the unique distribution pattern of this species, the ecoregional classification system does not provide a good description of the range. In BC there are four metapopulations of Caribou: southern mountain/arboreal; southern mountain terrestrial; northern mountain/terrestrial; boreal. These metapopulations consist of 13, 11, 17 and 1 sub-populations, respectively.

Has the range of Columbian Sharp-tailed Grouse changed?

- British Columbia has the largest remaining distribution of Columbian Sharp-tailed Grouse of any state or province. Six states average less than 10% of their original distribution and in a further three states they are extirpated.
- Columbian Sharp-tailed Grouse are stable in 53%, declining in 25% and extirpated in 22% of their historical range in British Columbia.
- Loss of the entire breeding population in the Kootenays is primarily due to forest encroachment on grasslands caused by successful fire suppression. Overgrazing, loss of riparian habitat, urban development and hunting also affect populations.

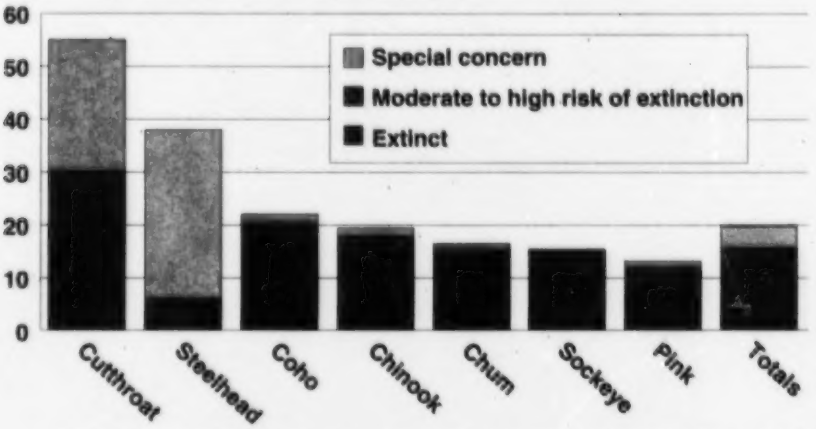


British Columbia is the largest remaining population centre of Columbian Sharp-tailed Grouse.

source: BC Ministry of Environment, Lands and Parks, Wildlife Branch, 1997.
NOTES: The delineations represent ecosections, as described in *Ecoregions of British Columbia*, D. Demarchi, 1993.

Fish in British Columbia

Percentage of salmonid stocks extinct, at moderate to high risk of extinction or of special concern



source: T.L. Slaney et al.,1996. *Status of Anadromous Salmon and Trout in British Columbia and Yukon*, Fisheries, V. 21, No.10, pp 20–35. NOTES: The graph displays the proportion of those stocks for which there was sufficient data to determine status. Of the approximately 10,000 stocks assessed in this study, the status of 80% of Cutthroat Trout, 48% of Steelhead, 50% of Coho, 51% of Chinook, 29% of Chum, 40% of Sockeye, 31% of Pink and 43% of all salmon stocks was unknown. At moderate to high risk means that the stock experienced serious declines in the last decade so that less than 20% or 1,000 fish (whichever is smaller) of the long-term population remains. Special concern means that the stock was at risk due to minor disturbances; is unique and requires special attention; may be at risk due to release of non-native fish; or that the current decade mean has fallen by 80% from long-term means, but the current decade mean is greater than 1,000. Yukon stocks and introduced stocks are not included in this graph.

844 salmon stocks of the approximately 10,000 investigated in British Columbia have been classified as extinct or at moderate to high risk of extinction.

Status and trends in salmonids

In recent years the low numbers of adult salmonids returning to spawn has raised alarm. For example, the percentage of steelhead smolts returning to spawn in the Keogh River on Vancouver Island has declined from an average of 15% prior to 1990 to less than 4% since 1991.

- The status of 43% of the salmon stocks in British Columbia is unknown. Of the 5,476 stocks which could be classified, 3% (142 stocks) are extinct 13% are at moderate to high risk of extinction and 4% are of special concern.
- An additional 22% of the unknown stocks may be at high risk or extinct, but the existing information is inconclusive.
- Cutthroat Trout has the greatest percentage of extinct stocks (13%), as well as the highest proportion (80%) of stocks whose status is unknown.
- Although Steelhead has the lowest proportion of stocks at moderate to high risk, 32% are classified "of special concern" and the status of 48% is unknown.
- Eighteen percent of Coho and 13% of Chinook stocks are at moderate to high risk of extinction. Chinook stocks are most at risk on Southwest Vancouver Island, while Coho stocks are most at risk on the Central Coast.
- Important factors contributing to extinct and declining salmon stocks are: loss of spawning habitat due to logging; hydro-power and urban development; overfishing; pollution; changes in the marine environment; and climate change.

Why is it important?

- Salmon are an integral part of British Columbia's culture, heritage and economy. Salmon have sustained aboriginal peoples for centuries and have supported commercial and recreational fisheries since the 1830s.
- Salmon bring essential marine-derived nutrients to British Columbia's coastal forest ecosystems.
- Although the province-wide abundance of some salmon species, such as Chum and Pink, is stable or increasing, declining stocks represent a loss of the genetic diversity that is essential to the long-term sustainability of salmon.

What is being done?

- The *Fish Protection Act* includes measures to protect and enhance fish habitat.
- The Watershed Restoration Program restores fish habitat in streams impacted by historical logging practices.
- The Urban Salmon Habitat Program provides funds to protect and restore urban streams in the Georgia Basin.
- Fisheries Renewal BC supports fish and fish habitat restoration work throughout British Columbia.
- The Water Use Planning process provides a mechanism to review BC Hydro's water licences and implement operational changes that will benefit fish.

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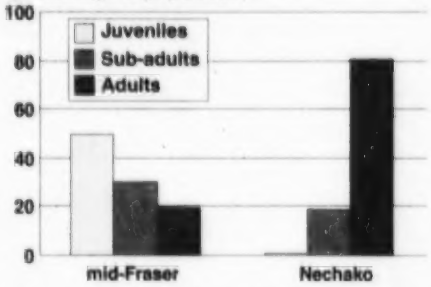
What is the status of White Sturgeon?

- The proportion of juveniles to sub-adults and adults is a good indicator of long-term viability for White Sturgeon. A viable population, such as in the mid-Fraser, is dominated by young Sturgeon. The near absence of juvenile fish indicates repeated spawning failures have occurred. Such a population may be considered critically imperilled.
- All White Sturgeon populations in BC are considered to be threatened, and three populations (Nechako, Kootenay, Columbia) are critically imperilled.
- Major dams and diversions that change the natural flow regime of spawning and rearing habitat present the greatest threat to Sturgeon.
- Other threats include pollutants and impacts to habitat through activities such as dredging and gravel mining.

Age distribution of White Sturgeon (percentage of population)



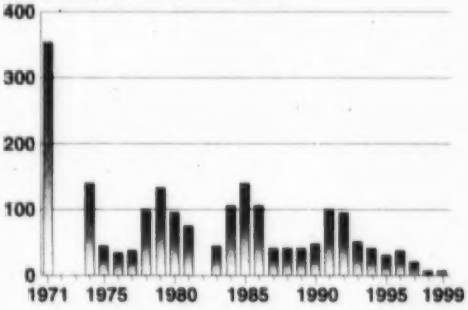
source: BC Fisheries, 1999. notes: Fraser data collected for area between French Bar Rapids and Hawkes Creek between 1997 and 1998. Nechako data collected from Nechako River between 1995 and 1998.

White Sturgeon are the largest freshwater fish in Canada. They spawn in only three river systems in North America – the Sacramento, Columbia and Fraser.

What is the status of Kokanee?

- The population of stream-spawning Kokanee in Okanagan Lake has declined by 98% since 1971, and the lake has been closed to angling since March 1995.
- Kokanee provide an important sport fishery in British Columbia's interior. They are the major food source for the region's large-lake Rainbow Trout populations, which are expected to decline if Kokanee continue their downward trend.
- Reasons for declining populations include loss of stream habitat through urbanization and development, and competition for food with introduced Oppossum Shrimp.
- Kokanee were successfully restored in Kootenay Lake through a fertilization program. It is unclear if nutrients are limiting Kokanee in Okanagan Lake and all restoration options are being considered.

Number of Kokanee spawners in streams of Okanagan Lake (thousands)

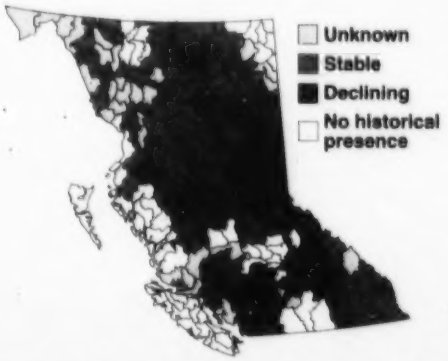


source: BC Fisheries and BC Ministry of Environment, Lands and Parks, 2000.

Kokanee stocks in the Okanagan region are highly susceptible to human impacts.

What is the status of Bull Trout?

- Bull Trout populations are declining in 41%, stable in 43% and have unknown status in 16% of the 183 watershed groups that historically contained Bull Trout.
- In British Columbia, Bull Trout is classified as vulnerable, and stringent fishing regulations are in place. In the US, some Bull Trout populations are listed as threatened under the *Endangered Species Act*.
- The main threats to Bull Trout are habitat loss and alteration caused by logging, grazing, mining, road building and dam construction.
- By increasing access, road development can lead to over-fishing and poaching.

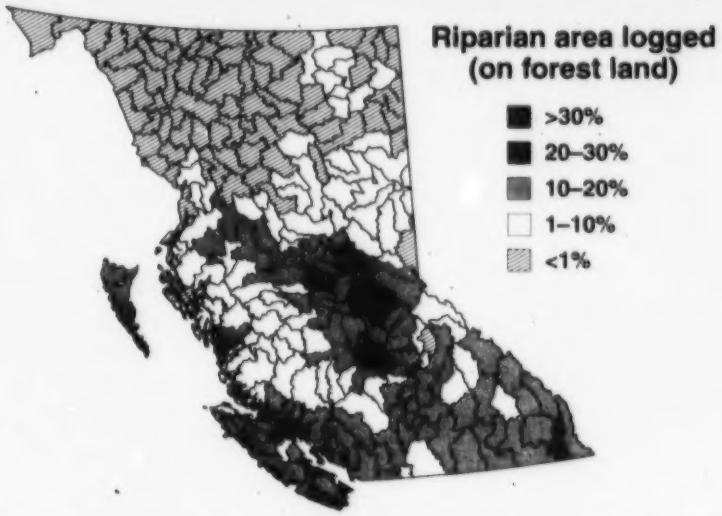


source: BC Fisheries and BC Ministry of Environment, Lands and Parks, 1999. notes: Population status data are based on professional opinion, as little hard data were available. This map delineates 246 watershed groupings, as described in the *British Columbia Watershed Atlas*. At least 183 of these watershed groupings have historically contained Bull Trout.

Bull Trout has been identified as a species requiring special management practices under the British Columbia Forest Practices Code.

Riparian Ecosystems on Forest Land

Riparian ecosystems cover only a small portion of the forest land in a watershed, but because they are often more diverse and productive than upland areas, they provide critical wildlife habitat.



source: BC Ministry of Environment, Lands and Parks, Geographic Data BC (GDBC), 1999. NOTES: For this map, riparian areas encompass the land within 30 metres of a stream, where a stream is greater than 200 m in length. Data have been extracted from the provincial database *Watersheds BC*. Data to create this map originate with the Baseline Thematic Mapping (BTM) Land Use/Ground Cover interpretation of satellite imagery, air photography, and 1:20,000 Ministry of Forests forest cover inventory. The BTM land use is from satellite imagery taken from 1991–1997. The map delineates 246 watershed groupings, as described in the *British Columbia Watershed Atlas*.

Since the implementation of the Forest Practices Code in 1995, logging of riparian areas beside medium to large streams has been significantly reduced. However, widespread retention of streamside vegetation beside smaller streams, less than 1.5 m wide, has not occurred.

Status of riparian ecosystems on forest land

- Forest riparian ecosystems are transitional areas between aquatic and upland forest ecosystems. At least 12% of the forest land area in the province is riparian.
- In almost one-third of the watershed groups, less than 1% of the forest riparian area was logged between 1973 and 1993, prior to the *Forest Practices Code*. Small streams are not captured by this analysis.
- During that time, in about 7% of the watershed groups, more than 20% of the forest riparian area was logged.
- Logging of riparian areas on forest land has been most widespread in the southern half of the province, including Vancouver Island, Queen Charlotte Islands, the south coast, the interior and the southeast of the province.
- Most (87%) of the logging in riparian areas has been by clearcutting; 13% has been by selectively logging.
- Past practices of logging and road building without the retention of streamside vegetation has highlighted the critical role that riparian habitat plays in maintaining aquatic ecosystem integrity.

Why is it important?

- Forest riparian ecosystems have an important role in stabilizing streambanks, regulating stream temperature and filtering out potentially harmful debris and pollutants.
- Forest riparian ecosystems produce a high diversity of plant species, which provide many opportunities to wildlife for nesting, feeding, hiding, roosting and use as migration corridors.
- Forest riparian ecosystems are a source of large woody debris that falls into streams, providing structural stability, complexity and nutrients to aquatic ecosystems.

What is being done?

- The *Forest Practices Code* (FPC) requires riparian reserve zones and management zones around larger streams containing fish.
- The Identified Wildlife Management Strategy enables habitat protection for species not adequately protected by general riparian and biodiversity measures under the FPC.

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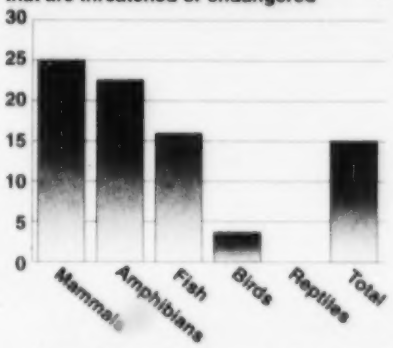
How are riparian-dwelling species faring?

- Of the 287 forest-dwelling vertebrate species in British Columbia, 88% use riparian habitat for their basic needs such as food, shelter and reproduction.
- 15% of the forest-dwelling vertebrates that depend on riparian habitat are listed as threatened or endangered. These include the Salish Sucker, Pacific Giant Salamander and Pacific Water Shrew.
- An additional 13% of riparian-dependent vertebrates are considered vulnerable and include Bull Trout, Canada Warbler and Fisher.

Percentage of riparian-dependent vertebrates that are threatened or endangered



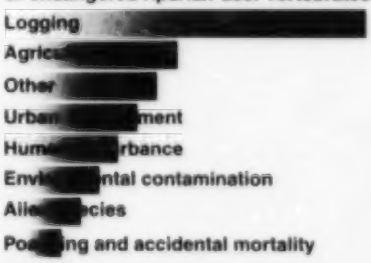
source: BC Ministry of Environment, Lands and Parks, 2000. Conservation Data Centre and State of Environment Reporting Program. notes: A riparian-dependent species is dependent on riparian habitat for at least one of its life stages. These data include subspecies when only one subspecies of a species is dependent on riparian habitat.

On the east coast of Vancouver Island a lack of forest cover in the riparian zone is one of the factors limiting fish populations in about two-thirds of the small streams.

What are threats to riparian species?

- Ninety percent of riparian vertebrate species at risk are threatened by logging activities. Examples include Western Red Bat, Grizzly Bear and Spotted Owl.
- Habitat loss due to logging, agriculture and urban development is the greatest threat to riparian vertebrate species at risk.
- Logging and associated road development also cause bank erosion, stream temperature changes, invertebrate (food for fish) community changes, nutrient input changes and increased access (roads and culverts).
- The threat labelled "other" includes alteration of habitat due to fire suppression and/or the effects of development not considered urban or agricultural (e.g., campsites).

Relative importance of threats to threatened or endangered riparian-user vertebrates

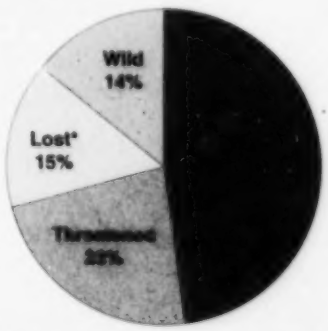


source: BC Ministry of Environment, Lands and Parks, 2000. State of Environment Reporting Program. notes: The analysis includes threatened or endangered species or candidates for this designation (i.e., Red-listed by the Conservation Data Centre (CDC)). "Other" includes alteration of habitats that are not urban or agricultural such as hydro, ski resorts and fire control. It does not include freshwater fish.

Seven riparian dependent species have been designated as "Identified Wildlife" under the Forest Practices Code.

What is the status of streams in the Lower Fraser Valley?

- Fifteen percent of the streams in the Lower Fraser Valley (LFV) have been lost and 71% are threatened or endangered.
- Streams are classified as threatened or endangered in response to a number of impacts on stream health, such as alterations to watersheds, streamside degradation, removal of vegetation and pollution.
- Only 14% (106) of streams in the LFV remain in a wild state. Most of these wild streams are high-gradient mountain streams, which are largely inaccessible to fish and relatively difficult to develop.
- The conversion of forests to agriculture, industry and housing in the LFV has caused severe damage to the streamside and in-stream habitat, including streams that once supported viable populations of salmon and other fish.
- Two-thirds of the wild Coho and 90% of the enhanced Coho in the Fraser River system spawn in the LFV.

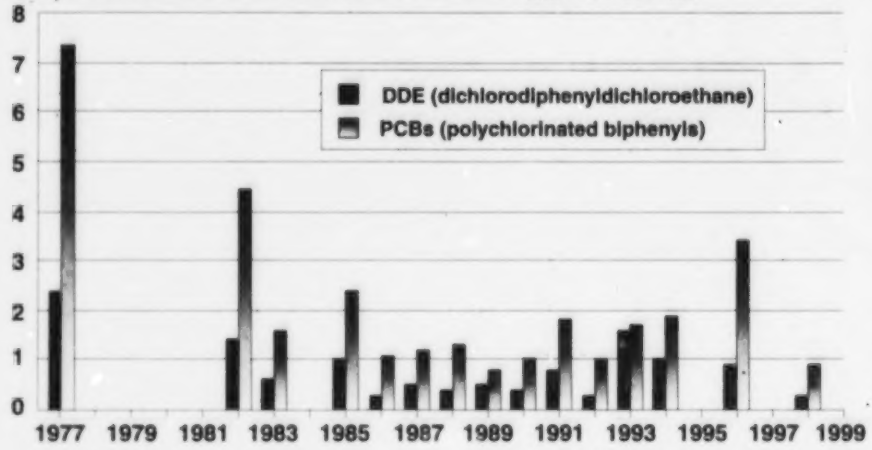


source: Fraser River Action Plan, Fisheries and Oceans Canada, 1998. notes: *The identification of historic streams that have been lost contains an element of uncertainty; therefore, the number of lost streams is considered an approximation. A threatened stream meets one impact criterion, an endangered stream meets more than one impact criterion and a wild stream is not significantly impacted by any impact criteria. Impact criteria include: riparian removal along more than 50% of fish-frequented length of stream; channelization/dyking of over 50% of fish-frequented length of stream; effective impermeable area (EIA) covering 10% or greater of watershed; water diversion of greater than 50% of stream flow or significant manipulation of flow; significant water problems (temperature, pH, BOD, nutrients, not including impacts from logging); extensive logging in the watershed where impacts are obvious; urbanization; and other agricultural/urban impacts.

Since 1860, in the Lower Fraser Valley, at least 117 streams have been lost — culverted, paved over, drained or filled in.

Toxic Contaminants in British Columbia

Contaminants in Great Blue Heron eggs (mg/kg)



SOURCE: Environment Canada, Canadian Wildlife Service, 1999. NOTES: Data are presented as geometric means of eggs sampled. Data for 1982, 1983, 1991, 1993, 1994, 1996 and 1998 are based on pooled samples. Data are from the Great Blue Heron colony at the University of British Columbia.

Since 1977 there has been a decrease in the levels of PCBs and DDE detected in the eggs of Great Blue Herons from a colony located near the University of British Columbia.

Status and trends in contaminants

- The level of contaminants found in some wildlife species has been decreasing over the past 20 years. Since 1977, PCB levels detected in Great Blue Heron eggs at the University of British Columbia (UBC) colony have decreased by between 40 and 89%.
- PCB manufacturing was banned in Canada in 1977, but PCBs are still present in electrical equipment manufactured before that date. Current levels of PCBs may be due to spills or leaks from old equipment or long-range atmospheric transportation and deposition.
- Since 1977, levels of DDE, a breakdown product of the persistent pesticide DDT, decreased by between 40 and 88% in Great Blue Heron eggs. Canada banned the use of DDT in the 1970s, but it persists in the environment and is still legally manufactured and used in some countries.
- Organochlorines, such as PCBs and DDE, are found in the eggs of other birds, such as Leach's Storm-Petrel, a predatory seabird. The presence of contaminants in remote bird populations found on the west coast of Vancouver Island illustrates how DDE and PCBs can be dispersed long distances through the atmosphere, fresh water and the ocean.

Persistent organic pollutants are transported long distances, by wind and water, until they settle at high latitudes and high altitudes. This is a problem in the mountains of British Columbia and in the Canadian Arctic.

Why is it important?

- Human activities, including industry, transportation, waste disposal, agriculture, forestry and recreation have contaminated the environment with substances that are toxic to humans and other living organisms.
- One group of toxic substances, persistent organochlorines, includes pesticides such as DDT and industrial compounds such as PCBs, dioxins (by-products of industrial processes) and furans. They are termed persistent because they linger in the environment for decades or even centuries before breaking down.
- These substances tend to accumulate within exposed organisms (bioaccumulation) and increase in concentration as they rise through the food chain (biomagnification).
- Top predators, such as the Great Blue Heron, are particularly affected.

What is being done?

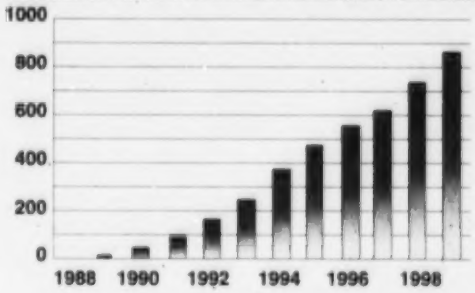
- Measures designed to minimize or eliminate exposure to contaminants include: stringent regulations for the management of toxic wastes; the use of pollution prevention planning; industry initiatives; and a program for responsible management of household hazardous waste.
- Pollution prevention planning encourages industry to reduce hazardous waste during the production process.

BRITISH COLUMBIA'S GOALS: *Clean, healthy and safe land, water and air for all living things, and provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment.*

Are contaminated sites being remediated?

- Since 1992 an average of 97 contaminated sites have been remediated per year.
- Contaminated sites pose a threat to human health, the environment and infrastructure. If contamination is not contained, it can spread, leading to very costly site clean-ups.
- The most typical contaminants at sites in British Columbia are petroleum hydrocarbons from gasoline stations. Other common contaminants include heavy metals and chlorinated hydrocarbons.

Cumulative number of contaminated sites remediated



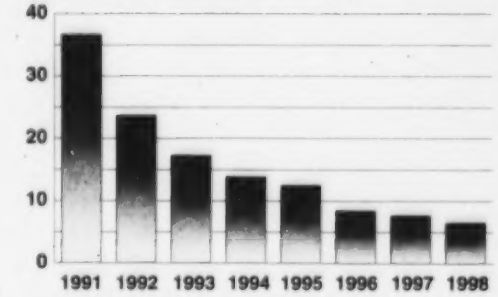
source: BC Ministry of Environment, Lands and Parks, 1999. Pollution Prevention and Remediation Branch. NOTES: Although 5,122 contaminated sites have been identified, after investigation not all of these will be found to be contaminated.

Between 1988 and 1999, 5,122 contaminated sites were identified and 867 were cleaned up.

Are measures to reduce pulp and paper effluent effective?

- AOX is a surrogate measure of the amount of chlorinated organic compounds in pulp and paper effluent discharge. Dioxins and furans are components of AOX.
- From 1991 to 1998, average AOX discharges were reduced by 82%, from 36.6 to 6.5 tonnes per day.
- In 1990 British Columbia established a legally binding requirement to eliminate AOX from the pulp and paper bleaching process by the end of 2002. New regulations will result in better tracking of progress towards AOX reductions.
- On-going improvements in the processing of pulp focus on reducing chlorine use and optimizing effluent treatment.

Adsorbable Organic Halide (AOX) discharges in pulp and paper effluent (tonnes/day)



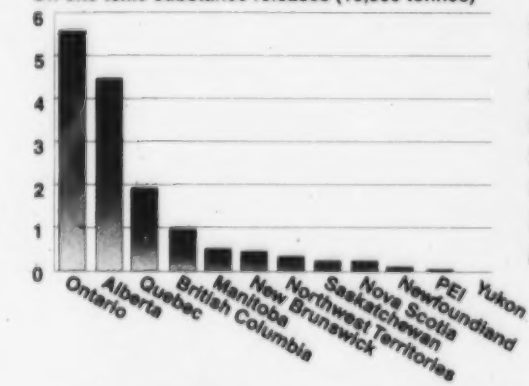
source: BC Ministry of Environment, Lands and Parks, 1999. Pollution Prevention and Remediation Branch.

Pulp and paper mills in British Columbia reduced AOX discharges by an average of 82% from 1991 to 1998.

How does British Columbia compare to other places?

- According to the National Pollutant Release Inventory (NPRI), Canada released 142,613 tonnes of on-site pollution in 1996.
- The majority (77%) of British Columbia's releases were into air, with 18% into water, 5% onto land, and less than 1% underground.
- In 1996, the two substances with the largest releases in British Columbia were methanol (3,501 tonnes) and ammonia (1,802 tonnes).
- Of the 176 substances tracked by NPRI, 10 have been classed as toxic, six identified as carcinogenic and nine as probably carcinogenic.
- Pollutant loading data give an indication of environmental stress, but cannot characterize the impact on environmental health.

On-site toxic substance releases (10,000 tonnes)



source: Environment Canada, 1998. *Summary Report 1996, the National Pollutant Release Inventory*. Data are for 1996, the latest year for which information is available. Data include permitted uses only.

On-site toxic releases have decreased in British Columbia from 32,079 tonnes in 1993 to 9,134 tonnes in 1996.

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